Division of Materials Engineering and Testing Services

Xenon Changeable Message Sign

Quality Assurance and Testing Guidelines

(PRELIMINARY DRAFT)

November 1, 2000

TABLE OF CONTENTS

TABLE OF CONTENTS (con't.)

APPENDIX

GLOSSARY

FIGURES

PURPOSE

The purpose of these guidelines is to help clarify the tasks involved in CMS quality assurance (QA) testing at the manufacturer's facilities. The intent is to provide basic information on how to ensure CMS systems currently being purchased by Caltrans are compliant with all applicable specifications. It is divided into two major parts. The first part is an expanded explanation of the common things to look for and test before accepting the CMS as compliant. The second part is a checklist, included in the appendix which should be copied, and used to record individual compliance test information for each sign tested. Last it should be noted that these are only guidelines for how to test, and not specifications. Where there is a conflict between the specifications and these guidelines, the specifications will always take precedence.

LIST OF EQUIPMENT

The following list outlines the equipment needed to properly perform a thorough QA test.

1) Tools:

   a. Slotted screwdriver
   b. Philips screwdriver
   c. Flashlight
   d. Standard tape measure
   e. Metric tape measure
   f. Laptop with Signview program installed
   g. Direct mode DB9 communications cable
   h. Digital multi-meter
   i. Amp probe

2) Applicable specifications:

   a. Transportation Electrical Equipment Specifications (TEES), November 19, 1999
   b. Transportation Electrical Equipment Specifications (TEES), Chapter 8 July1996
   c. CMS Specification Addendum to TEE's Chapter 8, November 1998
   d. Traffic Signal Control Equipment Specifications (TSCES), January 1989

Theory of Operation

There are four basic parts of the Changeable Message Sign (CMS) System:

1) Changeable Message Sign
2) Model 334 Cabinet Configured for CMS operation
3) Harness #4
4) Harness #5

The Changeable Message Sign is what you would normally see from the freeway displaying warning or informational messages and consists of several important parts. First is the Pixel Matrix Module's (PMM's) which is what actually displays messages, using Xenon lamps. Then, located in the right side of the sign chassis is the control compartment which contains, 4 step down transformers, the Pixel Driver Assemblies (PXDA's), Pixel Driver Modules (PDM's), CMS Isolation Module (CMS ISO MOD), Power Distribution Assembly #4 (PDA #4), and the CMS Interface Panel (CIP). The step down transformers reduce the incoming 120/240 VAC down to 20 VAC to power the PMM's. The PXDA's house the PDM's and provide interface between the PDM's and the PMM's. The PDM's are associated on a one for one basis with a PMM and provide their associated PMM lamps with data control. The CMS ISO MOD provides opto-isolation between the PDM cards and the PDA #4 to prevent damage to other electrical components should an electrical short occur. The PDA #4 provides 24 VDC power for the DC logic signals used by the CMS. Last, the CIP provides the ability to electrically disconnect all or part of the CMS though the use of a Main Disconnect Switch, and several smaller single pole circuit breakers for the PMM's.

The 334 Cabinet Assembly provides the "brains" for the CMS and uses a standard 170-E controller with operational program Signview. To accomplish this control, in addition to the 170 controller, the cabinet incorporates several other components which include, a Controller Isolation Assembly (CIA) and a Power Distribution Assembly #3 (PDA #3). Additionally, there is also a second CIA unit that is included as a spare, just incase the primary CIA should fail. The PDA #3 provides 24 VDC power to both the CIA and 170 controller. The CIA is the basic interface between the CMS and the 170-E controller located in the 334 Cabinet. Last, the CIA contains circuitry to electrically isolate all control signals between the CMS control compartment and the 170 controller in the 334 cabinet.

Harness #4 connects the CIA to the CMS Interface Terminal Block (CITB) mounted on the CIP. This allows signals to be sent through 24 multicolored pairs of #18 AWG, and provides control data from the 334 cabinet to the CMS.

Harness #5 connects the Terminal Block 1 in the model 334 cabinet to the CITB using 6 multicolored pairs of #18 AWG. This harness is used to provide feedback from the CMS to the 334 Cabinet.

Block Diagram

Figure 1 is a block diagram and shows the modularity of the system.

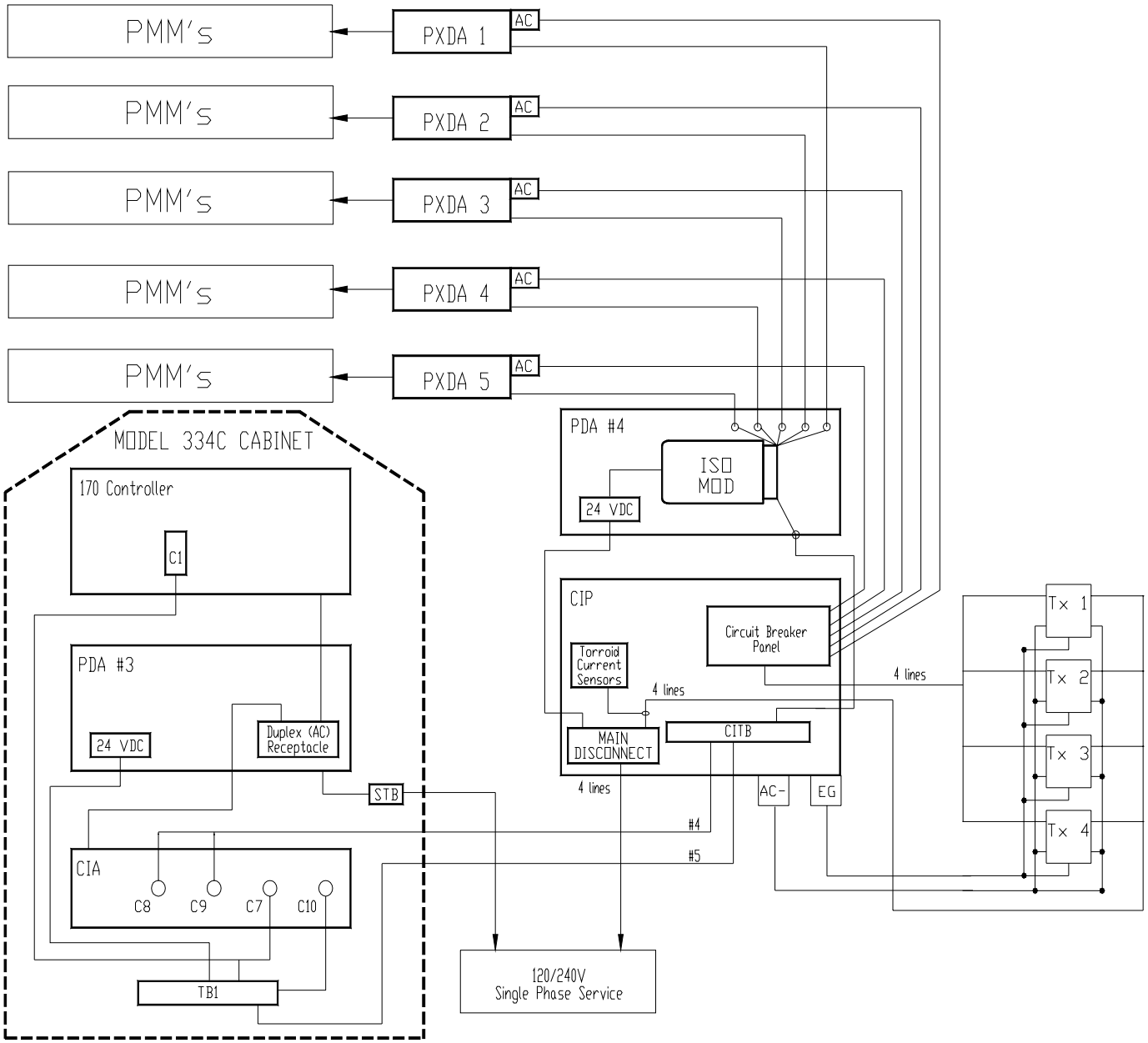


Fig. 1: Block Diagram of CMS System.

PREVIEW OF CMS SYSTEM LAYOUT

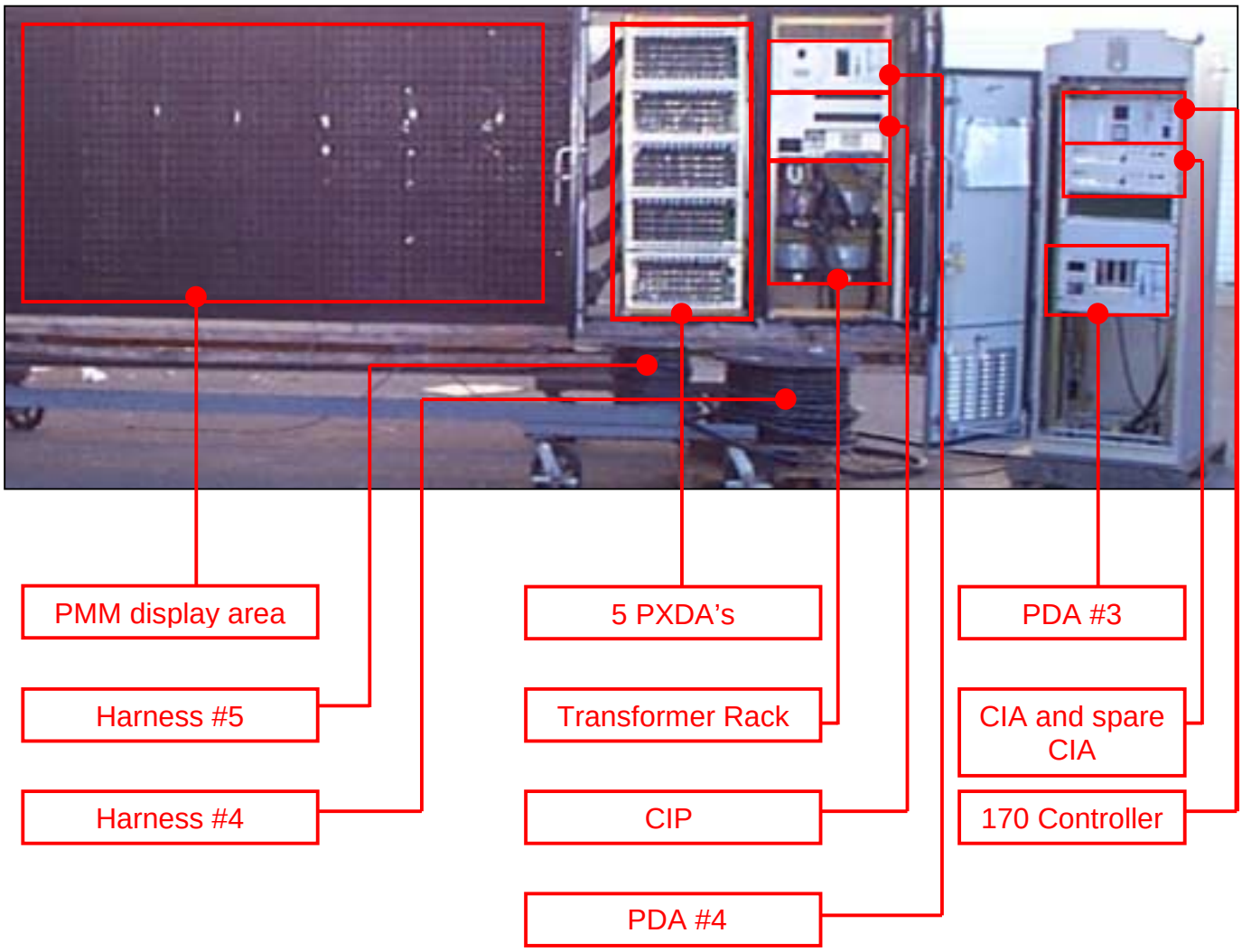


Fig. 2: CMS System Layout. Model 510 Shown.

QUALITY ASSURANCE AND TESTING GUIDELINES PHYSICAL INSPECTION

STRUCTURE AND HOUSING

1) Visually inspect overall appearance of housing structure. Verify the following conditions:

   a. Models 500 and 510 shall have a configuration of 5 PMM's high by 12 PMM's across (60 total), with the control compartment on the front right side of housing. (TEES July 1996 - SPEC 8.1.1 & 8.1.3)

   b. Model 520 shall have a configuration of 5 PMM's high by 6 PMM's across (30 total), with the control compartment on the rear of the housing. (TEES July 1996 - SPEC 8.1.2 & 8.1.4)

   c. 5" wide border (Models 510 and 520), 6" (Model 500), made of the same material as the housing shall encompass the PMM display area and enclose any open areas around the section. (TEES July 1996 - SPEC 8.3.1.2.7 & 8.3.1.2.8)

   d. Remove 3 PMM's from each row (right side, middle, left side), and verify housing has interior cage support and frames to mount PMM's and control compartment equipment. Each row shall also have a supported cable tray for routing harnesses to PMM's. Do not re-install PMM's at this time. (TEES July 1996 - SPEC 8.3.1.2.3 & 8.1.9.2.1)

   e. Lifting eyebolts are bolted through interior cage support and have a minimum diameter of 1.00 inch. "Lift Vertically to Prevent Damage" labels attached near each lifting eye bolt. (TEES July 1996 - SPEC 8.3.1.5)

2) Verify exterior housing dimensions, use figures 3,4 and 5 shown on the following pages as a guide:
(TEES July 1996 – Model 500 pages 8-8-1 & 8-8-2)
(TEES July 1996 – Model 510 pages 8-9-1 & 8-9-2)
(TEES July 1996 – Model 520 pages 8-10-1 & 8-10-2)

   a. Front View
   b. Side View.
   c. Rear View (Aluminum "Z" Bar)
   d. Top View (Eye bolts)
   e. Control Compartment
   f. Matrix Display Area Border
   g. Doors

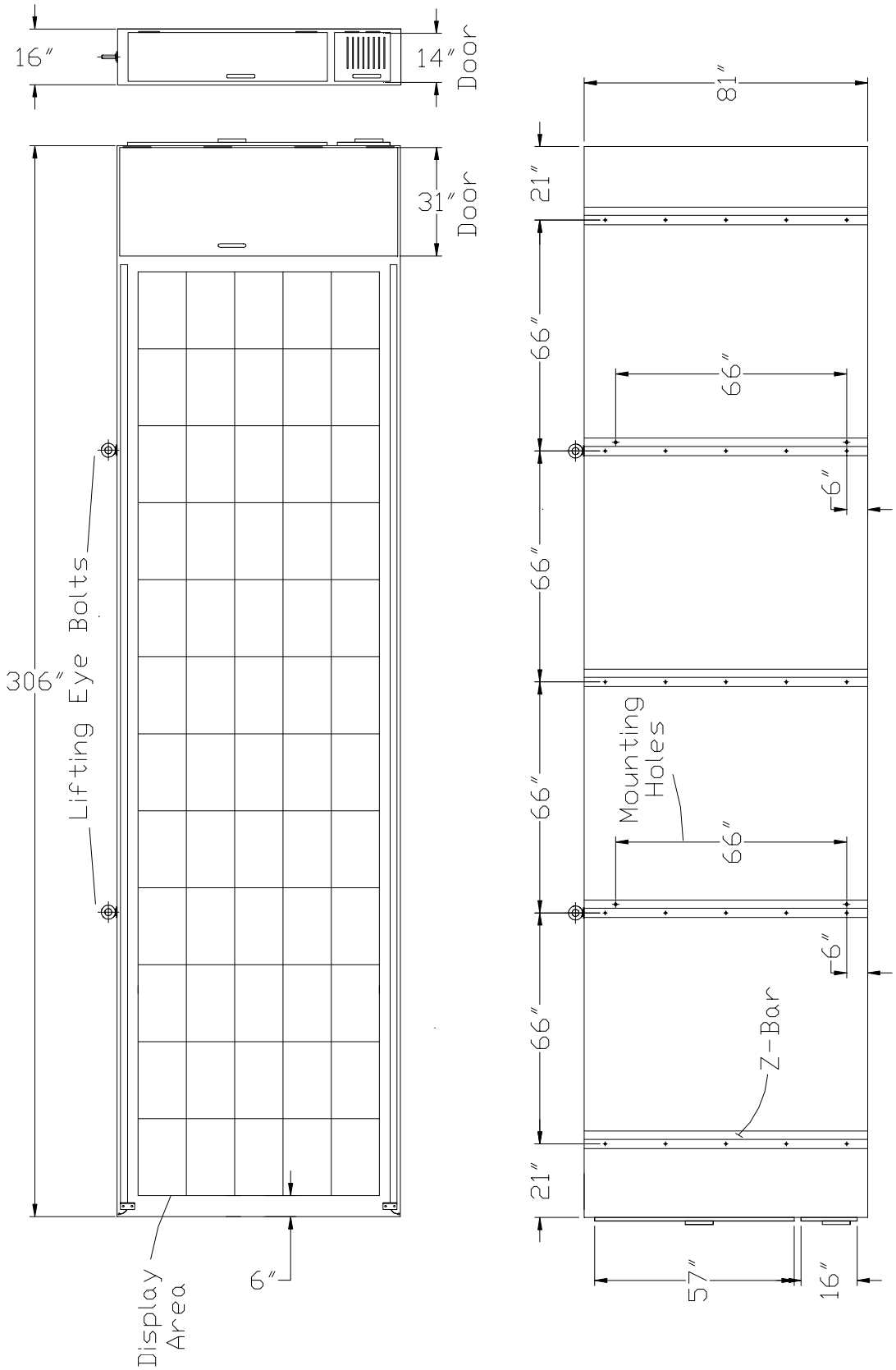


Fig. 3: CMS Model 500 Housing Dimensions.

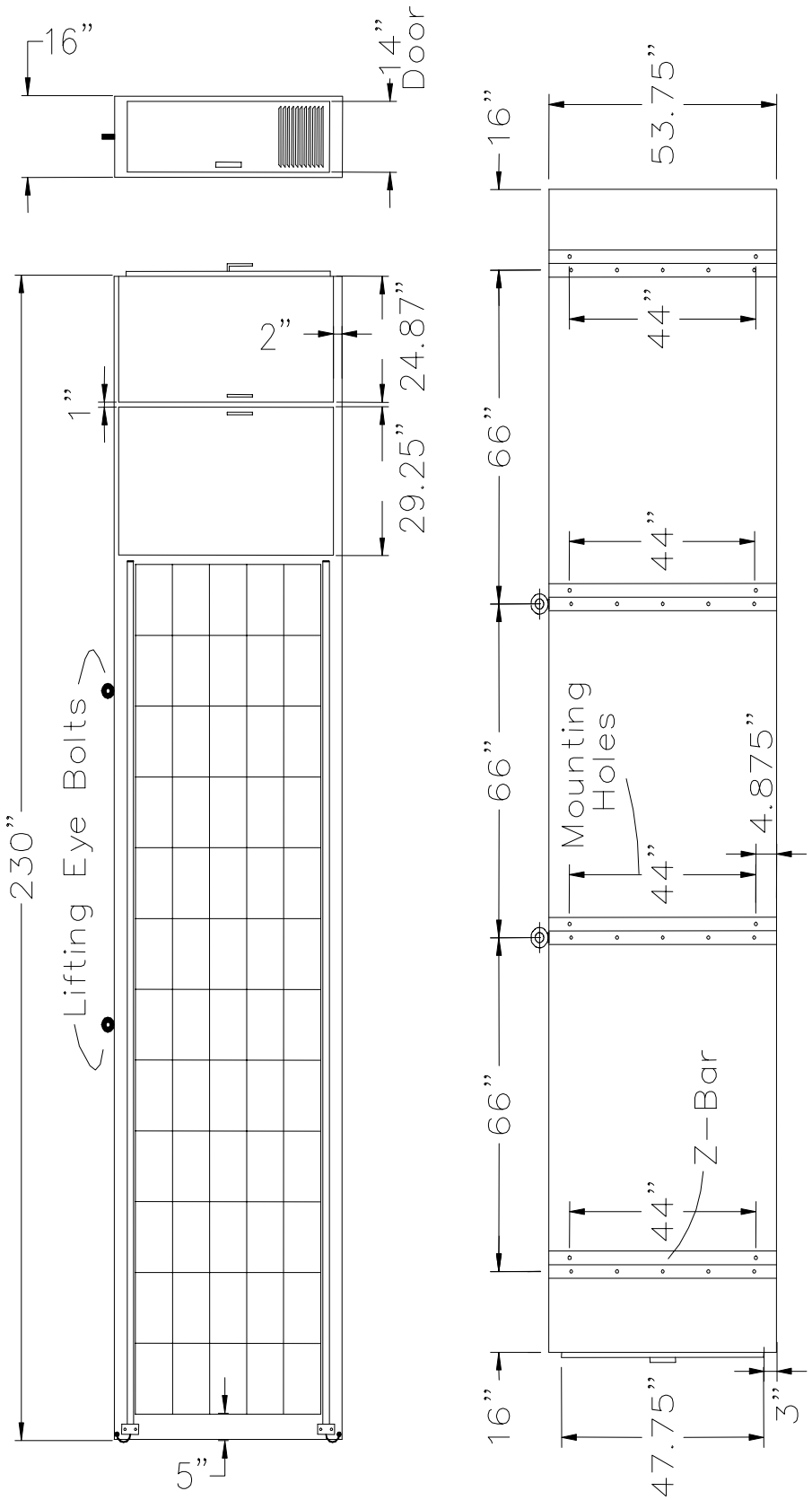


Fig. 4: CMS Model 510 Housing Dimensions.

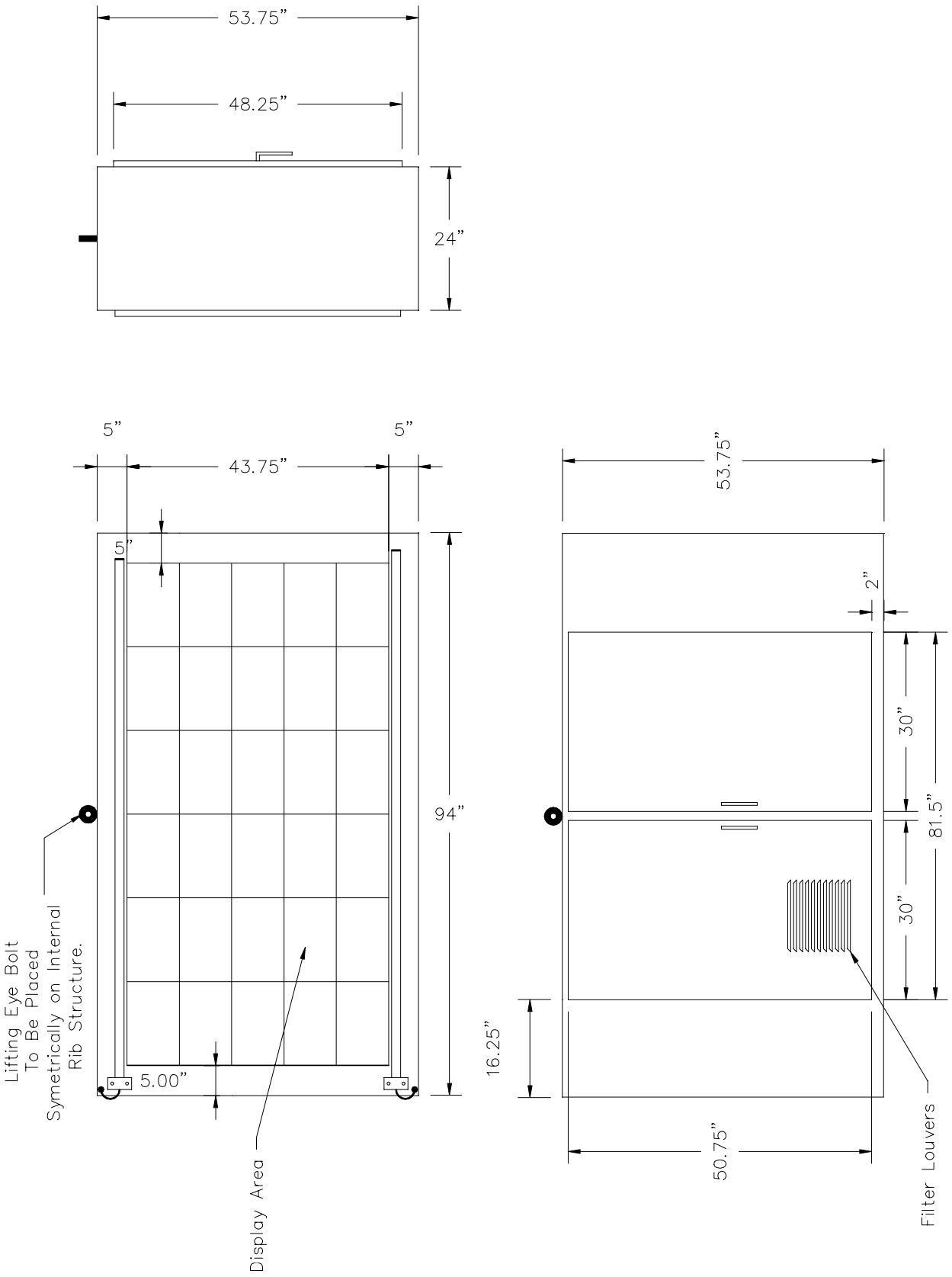


Fig. 5: CMS Model 520 Housing Dimensions.

1) Visually inspect quality of welds and verify the following conditions:
(TEES July 1996 - SPEC 8.3.1)

a. All exterior seams are continuously welded and have uniform flow.
b. Spatter welds are less than 3/8" in length. If longer than 3/8", defect should be ground off and re-welded.
c. Undercut welds are less than 3/8" in length. If longer than 3/8", defect should be ground off and re-welded.

Fig. 6: Example of Continuous Weld with Uniform Flow.

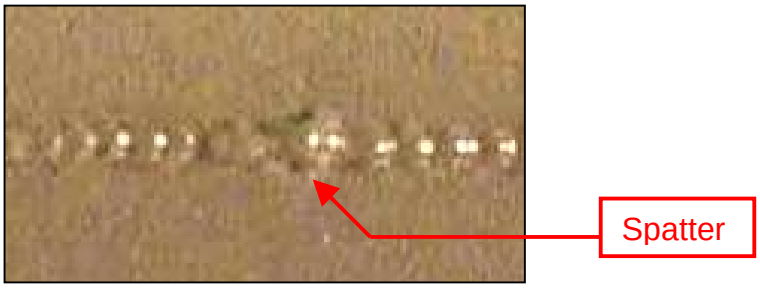


Fig. 7: Example of Spatter Weld.

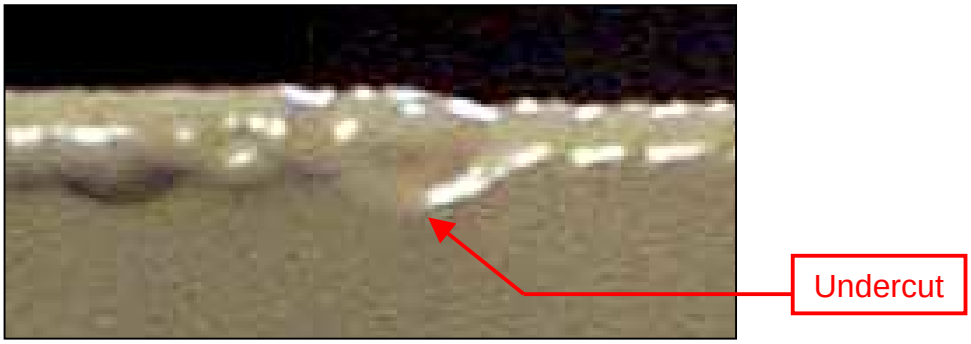


Fig. 8: Example of Undercut Weld.

1) Verify dimensions and mounting of Z-bar to the rear of the CMS. This applies to Models 500 and 510 only, Model 520 does not require Z-bar. Verify the following conditions:
(TEES July 1996 - Model 500 page 8-8-2)
(TEES July 1996 - Model 510 page 8-9-2)

   a. Bolt supports to CMS housing, minimum of 5 bolts per Z-bar.
   b. Pre-drilled 3/4" diameter mounting holes.

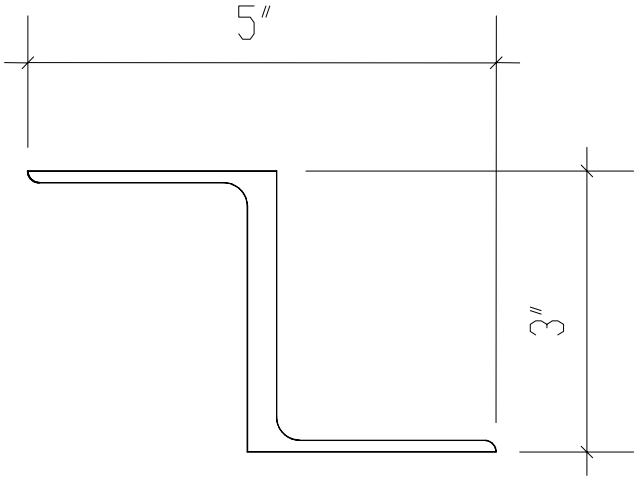


Fig. 9: Cross-Section of Z-Bar.

2) Inspect the doors and verify the following conditions:

   a. Gaskets (TEES July 1996 - SPEC 8.3.1.3.5)
   b. Placement (TEES July 1996 - SPEC 8.3.1.4.1.1 & 8.3.1.4.1.2)
   c. Components (TEES July 1996 - SPEC 8.3.1.4.1.3 to 8.3.1.4.1.5)
   d. Catches at 90^0 and 180^0 (TEES July 1996 - SPEC 8.3.1.4.1.6)
   e. Side access doors (TEES July 1996 - SPEC 8.3.1.4.2.1)

3) A verification of the total weight shall be documented and included in a Certificate of Compliance.
(TEES July 1996 - SPEC 8.1.7)

   Verify total weight of CMS does not exceed:

   a. Model 500 - 2400 pounds
   b. Model 510 - 2000 pounds
   c. Model 520 - 1000 pounds

4) Verify the following spare parts are packaged with each CMS.
(TEES July 1996 – SPEC 8.1.10)

   a. 1 each - PMM
   b. 5 each - PDM
   c. 1 each - PXDA
   d. 1 each - CMS Isolation Module
   e. 1 each - CIA

SCREEN ASSEMBLY

1) Visually inspect the screen assembly for damage or physical defects. Verify the following conditions:

   a. Profile angle @ 20 degrees. (TEES July 1996 - SPEC8.3.5.1.1)
   b. Panel overlap to minimize lamp blockage. (TEES July 1996 - SPEC 8.3.5.2)
   c. Panels provided with dampening material. (TEES July 1996 - SPEC 8.3.5.2.1)

2) Verify the proper number of screen panels are installed:

   a. Model 500 - 6 panels. (TEES July 1996 - SPEC 8.3.5.1)
   b. Model 510 - 4 panels. (TEES July 1996 - SPEC 8.3.5.1)
   c. Model 520 - 2 panels. (TEES July 1996 - SPEC 8.3.5.1)

3) Verify removable pin latches are installed to lock screen panels in a fixed position. The latches shall be operated using only common hand tools.
(TEES July 1996 - SPEC 8.3.5.2 & 8.3.5.2.3)

4) Verify dual tracks are properly mounted above and below the PMM display area. Tracks shall be permanently mounted and not pull away from housing when releasing screen pin latches.
(TEES July 1996 - SPEC 8.3.5.2)

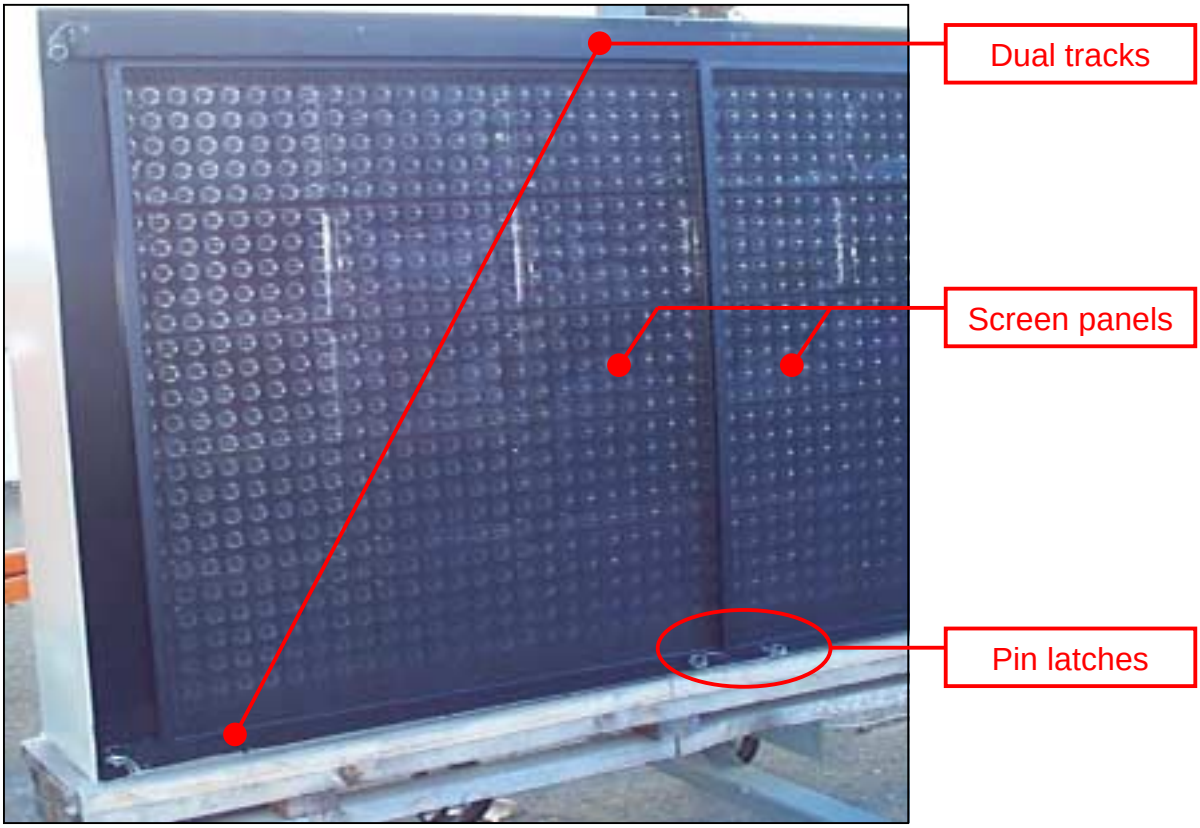


Fig. 10: Screen Assembly.

5) Verify left end sides of dual tracks are provided with a removable end cap. (TEES July 1996 - SPEC 8.3.5.2.4)

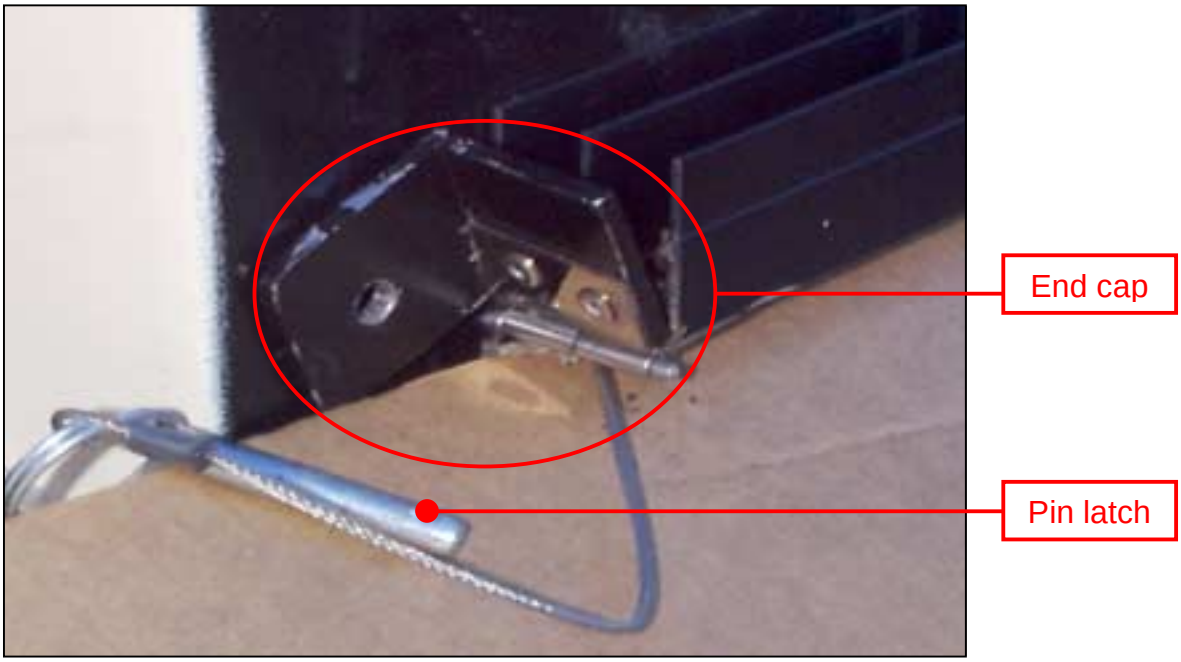


Fig. 11: Example of Removable End Cap.

HARNESS #1 (Connectors CA, CB, CC)

1) A harness #1 is connected between each PMM and its associated PXDA. Remove one PMM and one PXDA, then verify the following components:
(TEES July 1996 - SPEC 8.1.9.1 & 8.1.9.1.1)

   a. Disassemble one CA or CB connector and slide it back to verify #22 AWG or larger conductors are used.
   b. 1 CAS Connector.
   c. 1 CBS Connector.
   d. 1 CCS Connector.

Fig. 12: Disassembled Connector.

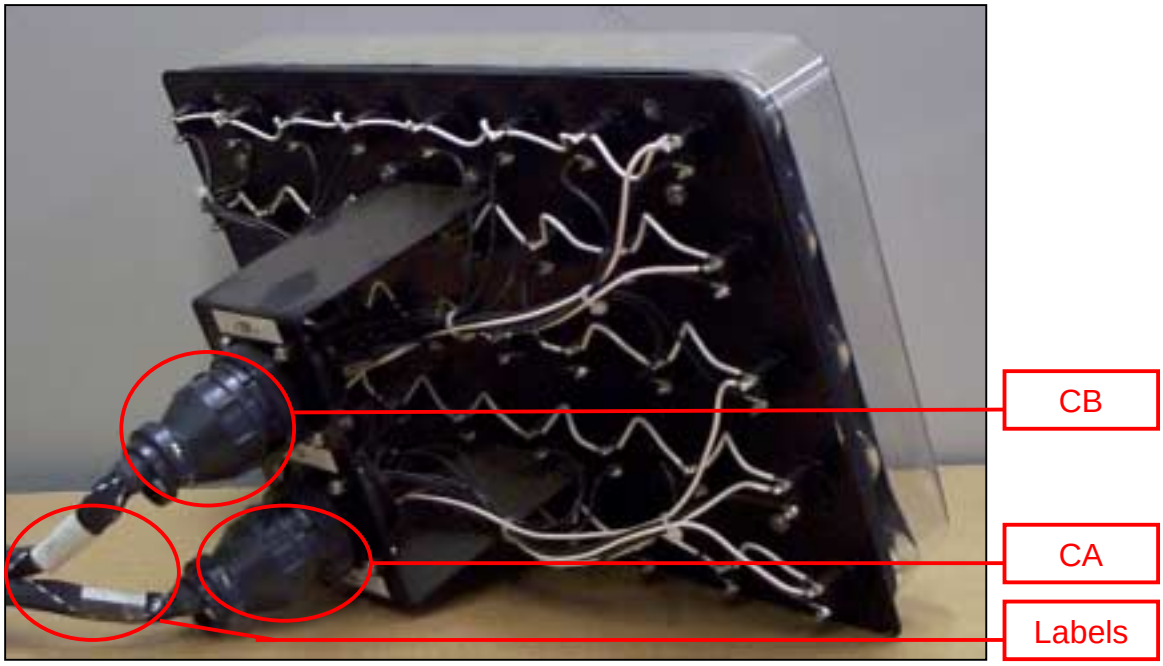


Fig. 13: PMM Removed to Show CA and CB Connectors.

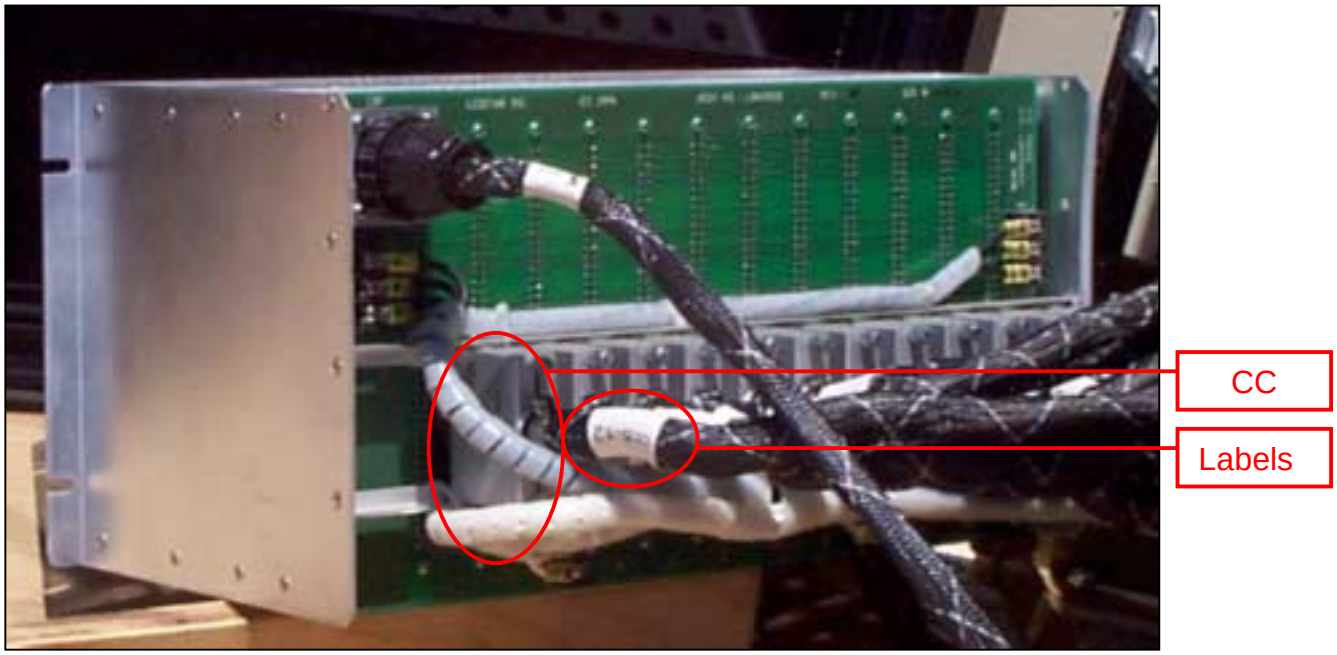


Fig.14: PXDA Removed to Show CC connector.

2) Verify CA, CB and CC connectors are the correct type called for in TEES July 1996 (page 8-7-17) shown below.

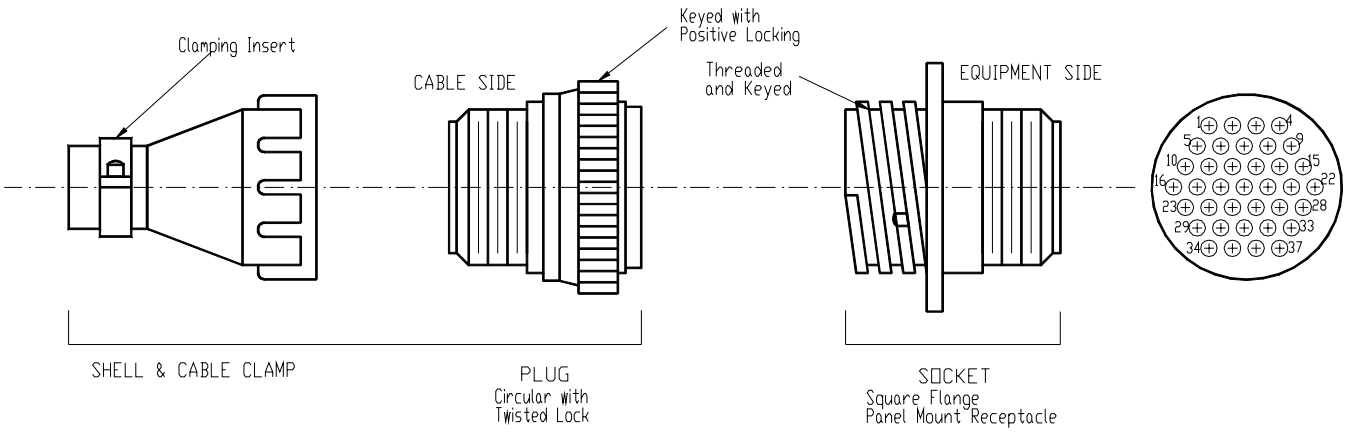


Fig. 15: CA and CB Connector Specifications.

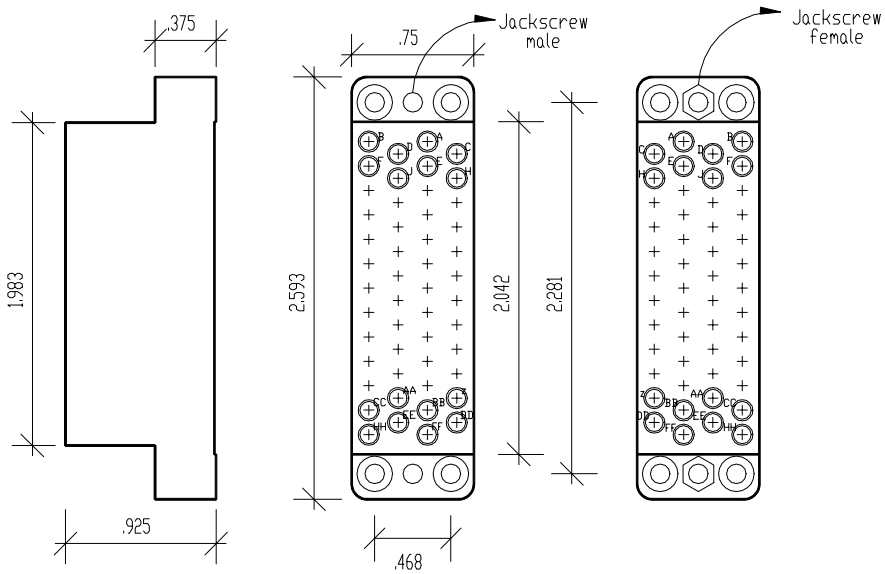


Fig. 16: CC Connector Specifications.

1) Verify enough slack is provided to completely remove the PXDA's from the equipment rack.
(TEES July 1996 - SPEC 8.1.9.8)

2) Verify cables have labels, identifying where each is to be connected.
(TEES July 1996 - SPEC 8.1.9.7)

3) Verify CA and CB connectors are keyed to prevent improper insertion.
(TEES July 1996 - page 8-7-18)

Fig. 17: Keyed Positions for CA and CB Connectors.

HARNESS #2 (CONNECTORS CD, CE)

1) A harness #2 is connected between each PXDA CD connector and the associated PDA #4 CE connector. Remove one PXDA and the PDA #4, then verify the following conditions:
(TEES July 1996 - SPEC 8.1.9.2 & 8.1.9.2.1)

   a. Disassemble CD connector and slide it back to verify #22 AWG or larger conductors are used
   b. 1 CD Connector
   c. 1 CE Connector

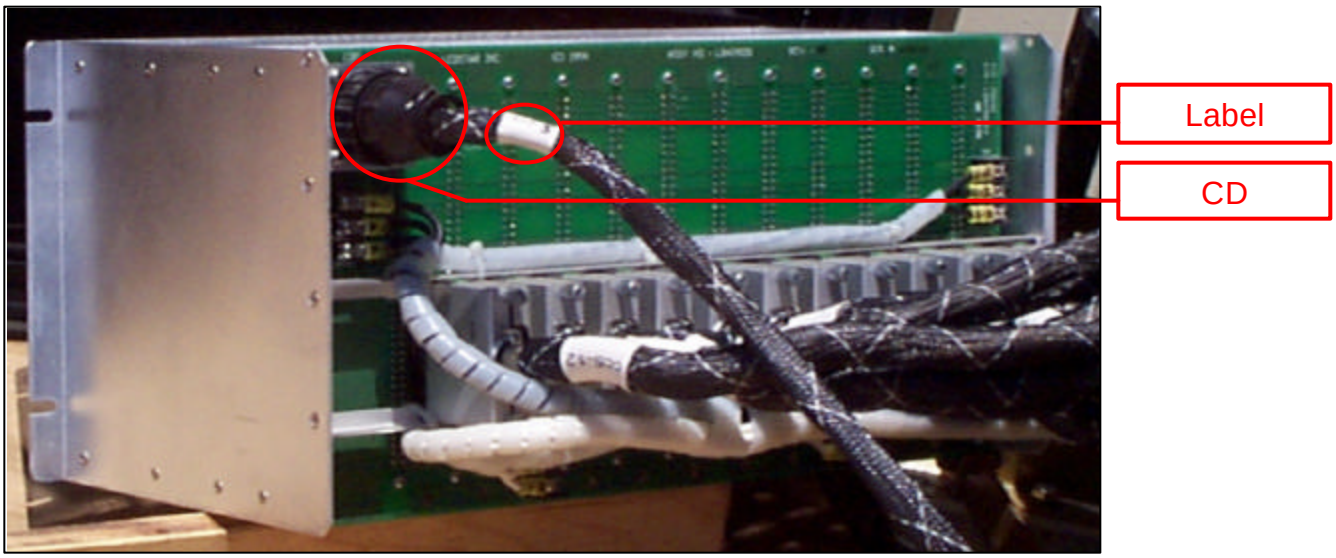


Fig.18: PXDA Removed to Show CD Connector.

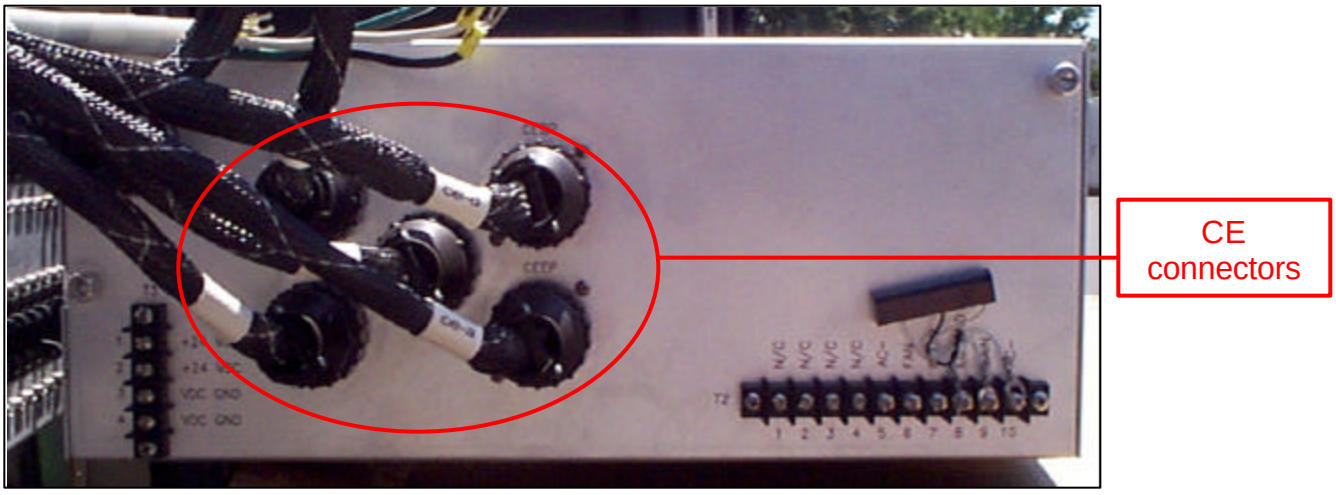


Fig.19: PDA #4 Removed to Show CE Connectors.

2) Verify CD and CE connectors are the correct type called for in TEES (page 8-7-17) shown below.

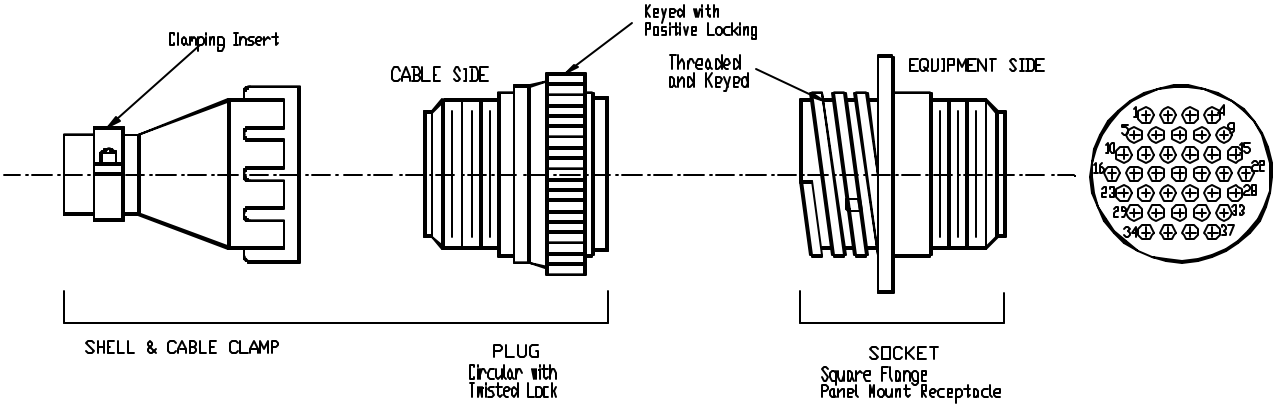


Fig. 20: CD and CE Connector Specifications.

3) Verify cables have labels, identifying where each is to be connected. (TEES July 1996 - SPEC 8.1.9.7)

4) Ensure CD and CE connectors have the proper pin-out assignments by verifying internal pins are not installed in positions marked “NA”. (TEES July 1996 - page 8-7-19)

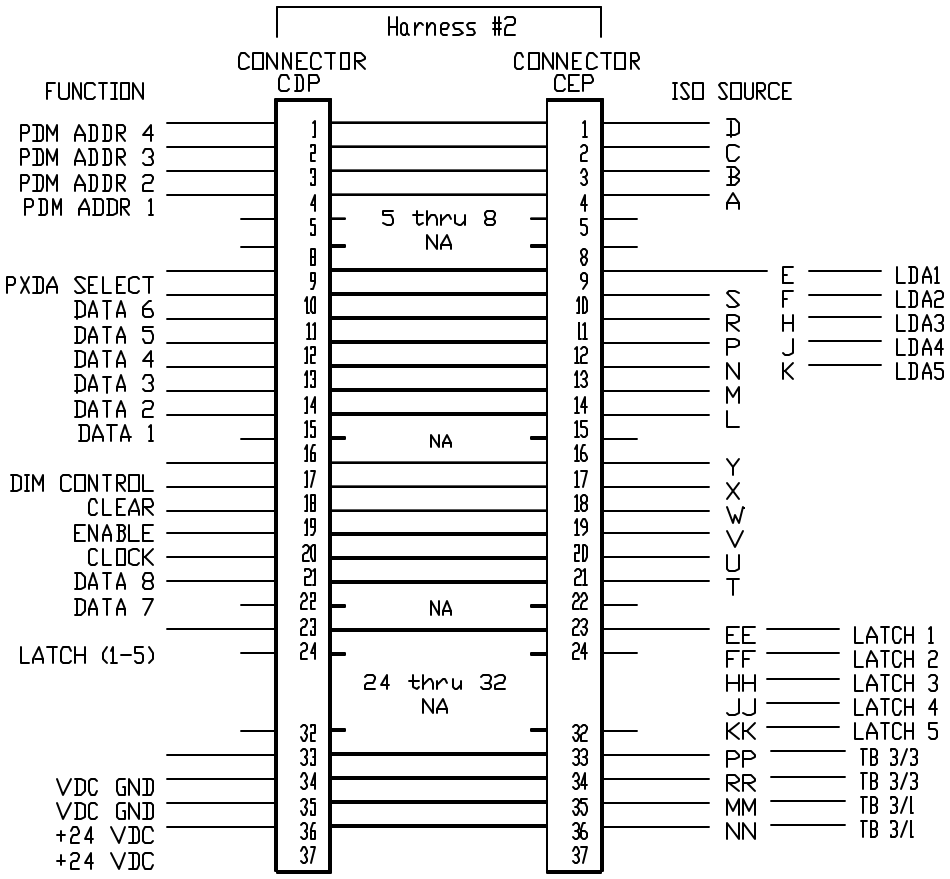


Fig. 21: CD and CE Connector Pin-Out Assignments.

HARNESS #3 (CONNECTOR CF)

1) A harness #3 is connected between the PDA #4 CF connector and the rear of the CITB mounted on the CIP. Remove the PDA #4 and CIP front panel, then verify the following conditions:
(TEES July 1996 - SPEC 8.1.9.3 & 8.1.9.3.1)

   a. # 22 AWG or larger conductors
   b. 1 CF Connector
   c. Bare conductors stripped and tinned

Fig. 22: PDA #4 Removed to Show CF Connector.

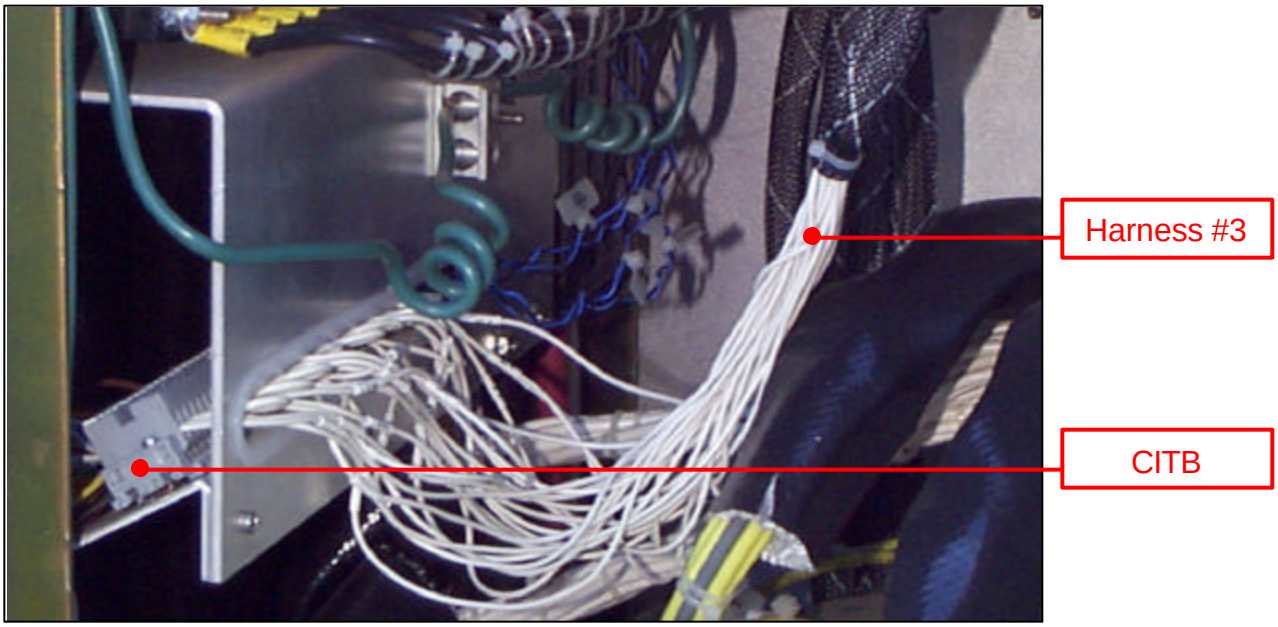


Fig. 23: Rear View of CIP Showing Termination of Harness #3.

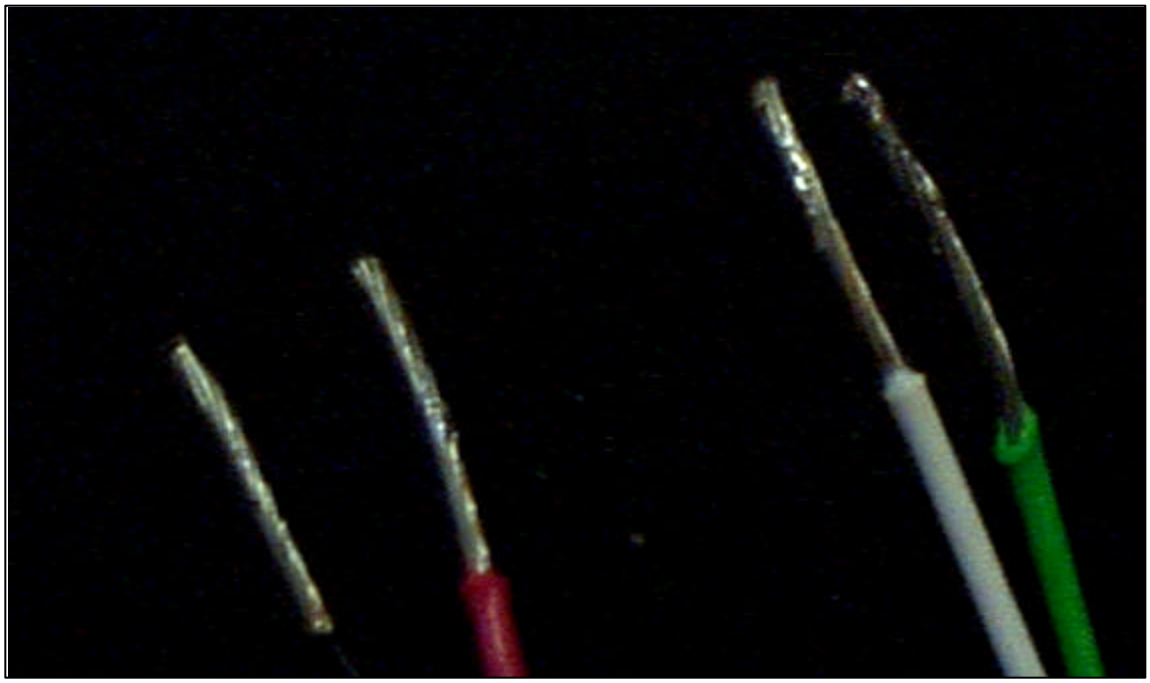


Fig. 24: Bare Conductor Ends Stripped and Tinned.

2) Verify CF connector is the correct type called for in TEES (page 8-7-17) shown below.

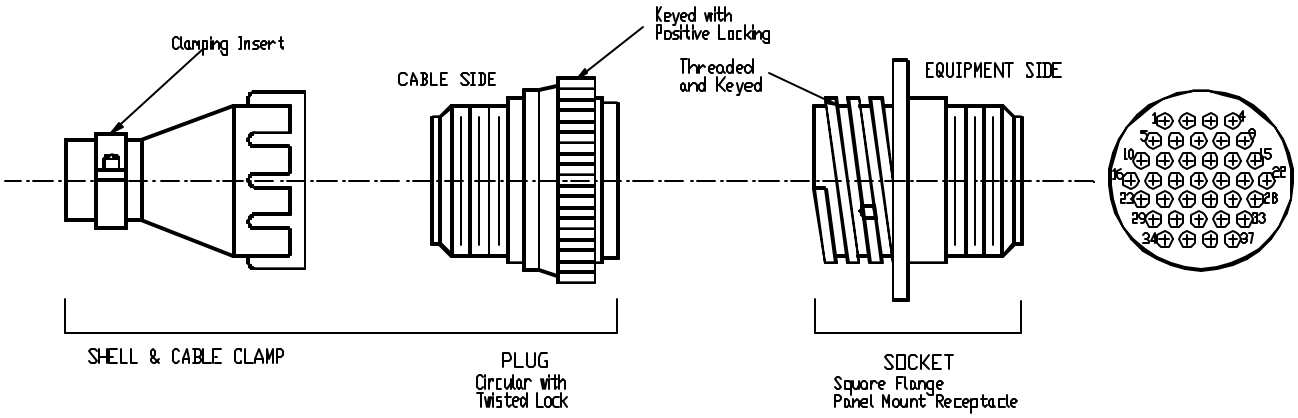


Fig. 25: CF Connector Specifications.

3) Verify cables have labels, identifying where each is to be connected. (TEES July 1996 - SPEC 8.1.9.7)

4) Ensure CF connector has the proper pin-out assignments by verifying internal pins are not installed in positions marked “NA”.
(TEES July 1996 - page 8-7-20)

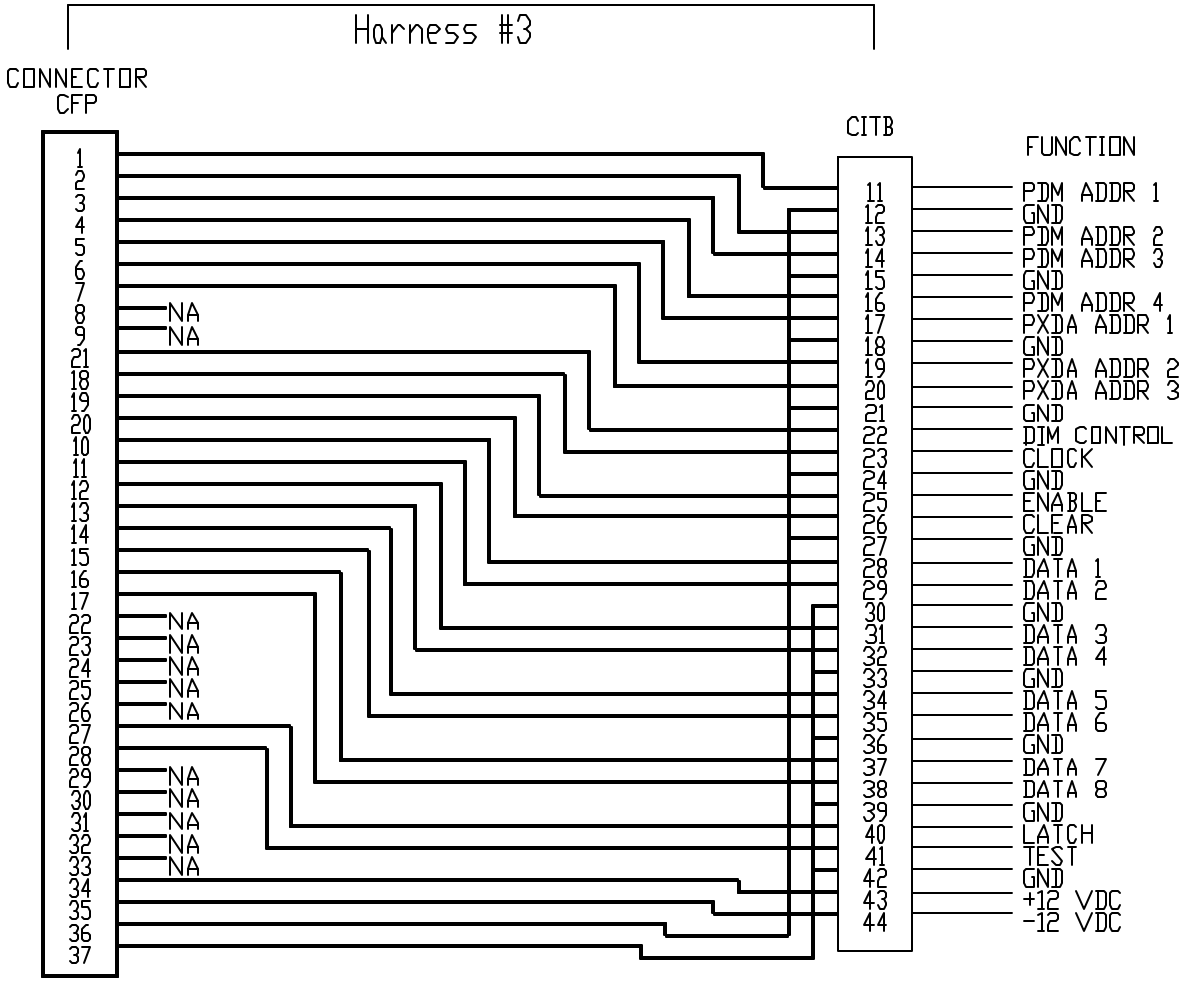


Fig. 26: CF Connector Pin-Out Assignments.

HARNESS # 4 (CONNECTORS C8, C9)

1) A harness #4 is connected between the CIA in 334C Cabinet, C8 & C9 connectors, and the CITB mounted on the CIP. Disconnect the harness and verify the following conditions:
(TEES July 1996 – SPEC 8.1.9.4.1)

a. 300 feet of Atlas Cable, Type A-881 or equal, 24 pr. #18 AWG multicolored
b. Conductors stripped and tinned
c. 1 C8 Connector
d. 1 C9 Connector

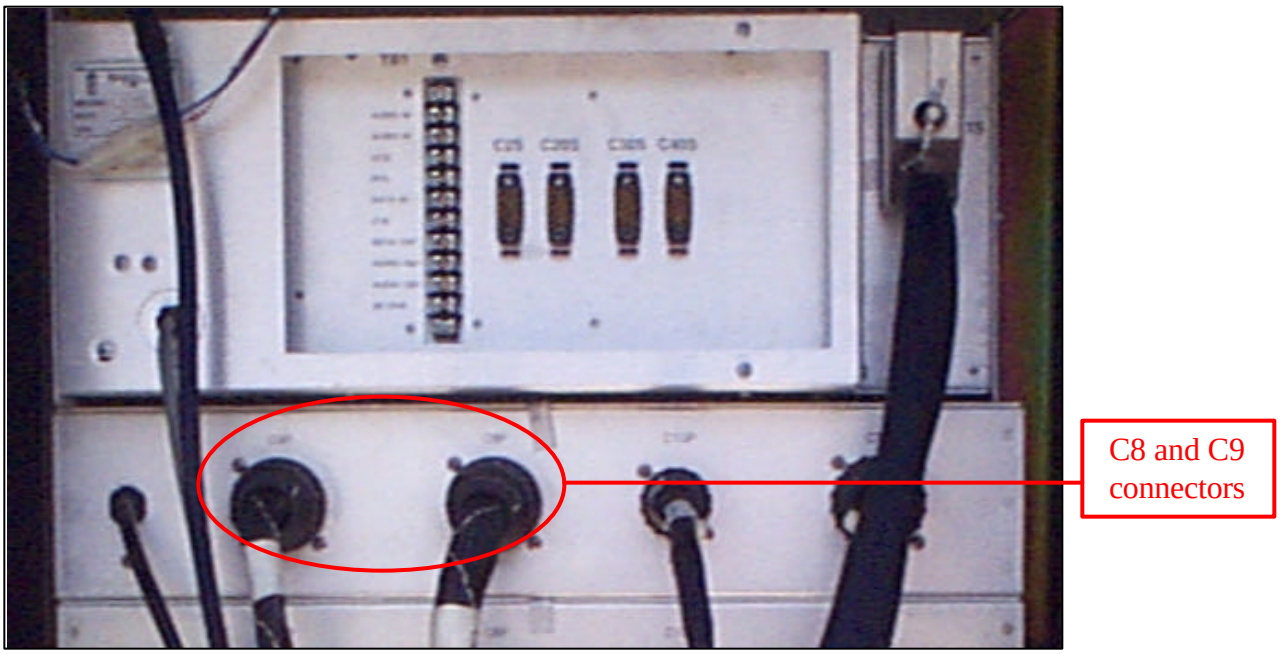


Fig. 27: C8 and C9 Connectors on Rear of CIA Inside 334C Cabinet.

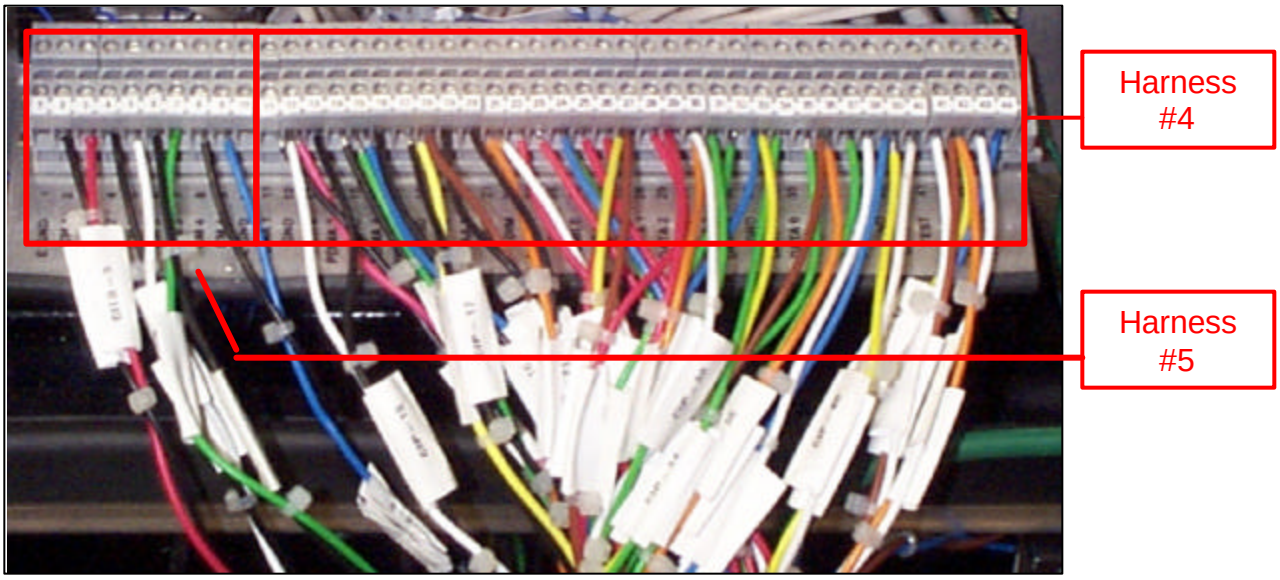


Fig. 28: Termination of Harness #4 at CITB Mounted on CIP.

2) Verify C8 and C9 connectors are the correct type called for in TEES (page 8-7-17) shown below.

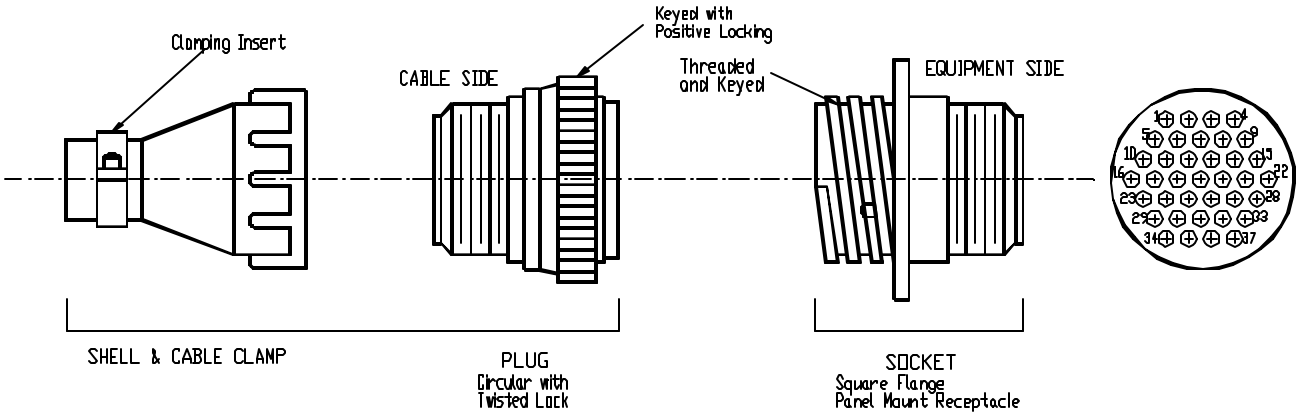


Fig. 29: C8 and C9 Connector Specifications.

3) Verify cables have labels, identifying where each is to be connected. (TEES July 1996 - SPEC 8.1.9.7)

4) Verify C8 and C9 connectors are keyed to prevent improper insertion. (TEES July 1996 – page 8-7-28)

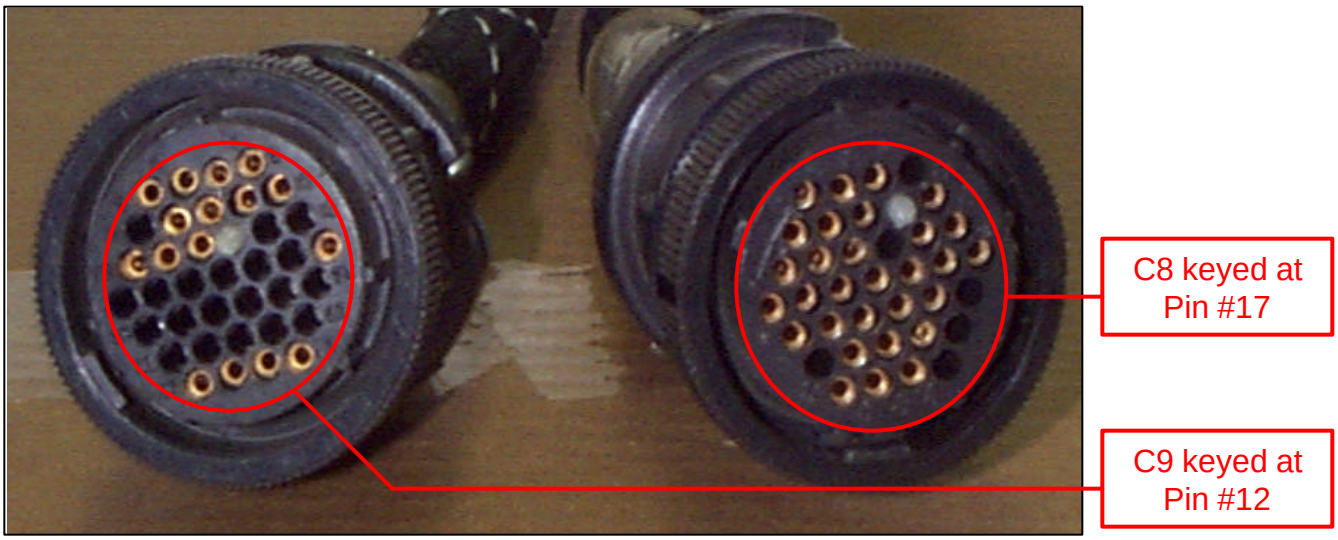


Fig. 30: Keyed Positions for C8 and C9 Connectors.

5) Verify Harness #4 is neatly rolled up on a wooden reel and prepared for shipping. (TEES July 1996 - SPEC 8.1.9.6)

HARNESS # 5

1) A harness #5 is connected between the CITB and terminal block 1 (TB1) in rear of 334C Cabinet. Disconnect the harness and verify the following conditions. (TEES July 1996 – SPEC 8.1.9.5.1)

   a. 300 feet of Atlas Cable, Type A-881 or equal, 6 pr. #18 AWG multicolored
   b. Conductors stripped and tinned

2) Verify conductors have labels, identifying where each is to be connected. (TEES July 1996 - SPEC 8.1,9,7)

3) Verify Harness #5 is neatly rolled up on a wooden reel and prepared for shipping. (TEES July 1996 - SPEC 8.1.9.6)

CHANGEABLE MESSAGE SIGN INTERFACE PANEL (CIP)

1) Verify panel dimensions and labeling is correct as shown below. (TEES July 1996 - page 8-7-10)

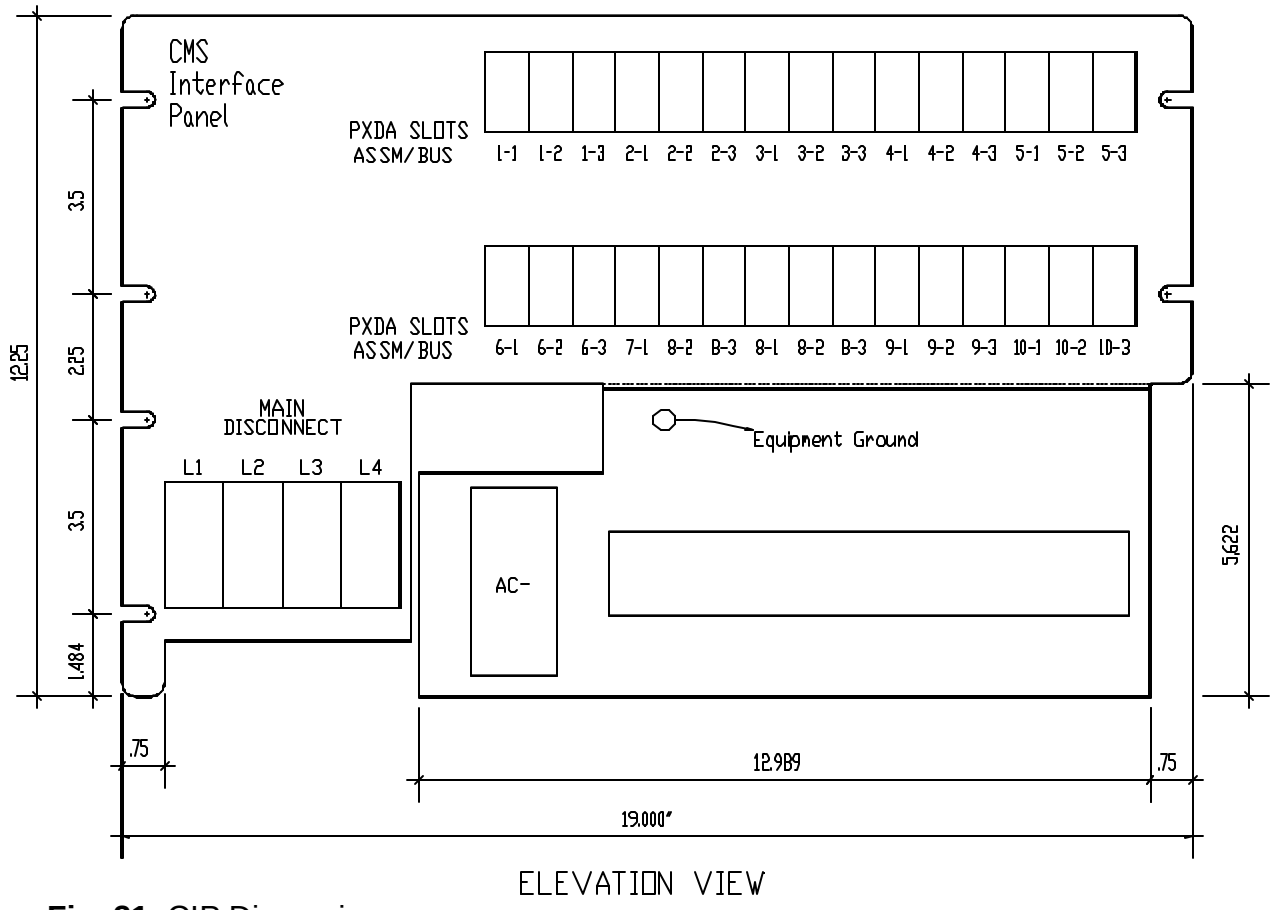


Fig. 31: CIP Dimensions.

2) Verify the CMS disconnect switch or circuit breaker is a 4-pole, 100 Amp minimum that can accommodate No. 1/0 AWG conductors. Four single-pole ganged circuit breakers are allowed, as long as the total amperage adds up to a minimum of 100 Amps,
(TEES July 1996 - SPEC 8.4.3.6)

3) Inspect the AC Neutral Bus and verify the following components:
(TEES July 1996 - SPEC 8.4.3.3)

a. Two 1/0 AWG wiring lugs or one 2-position lug
b. Nylon screws or standoffs
c. 20-position minimum AC- buses

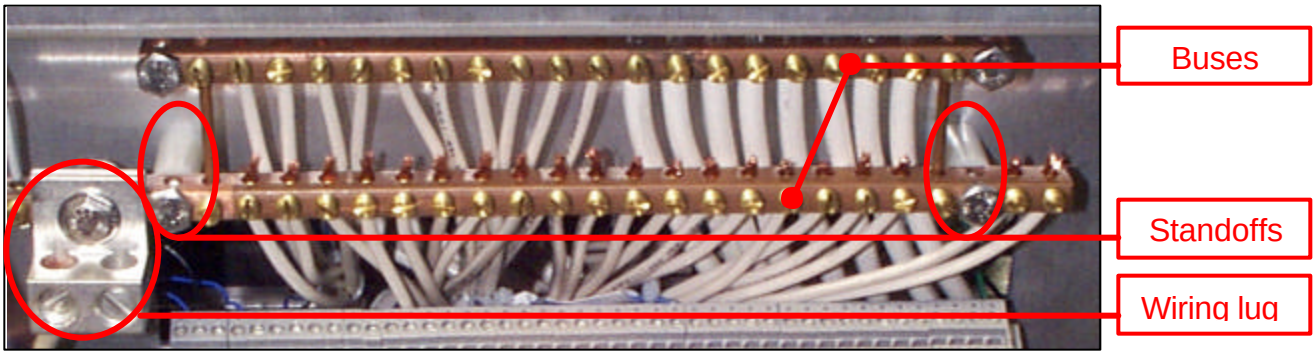


Fig. 32: Example of AC Neutral Bus Assembly.

4) Inspect equipment ground and verify the following conditions:
(TEES July 1996 - SPEC 8.4.3.4)

a. A 2-position termination lug mounted on rear of CIP panel for equipment ground
b. A #10 AWG conductor routed from CMS frame termination to the CIP termination lug
c. A #10 AWG conductor routed from the CIP termination lug to PDA #4, terminal block 2 (T2) position 8

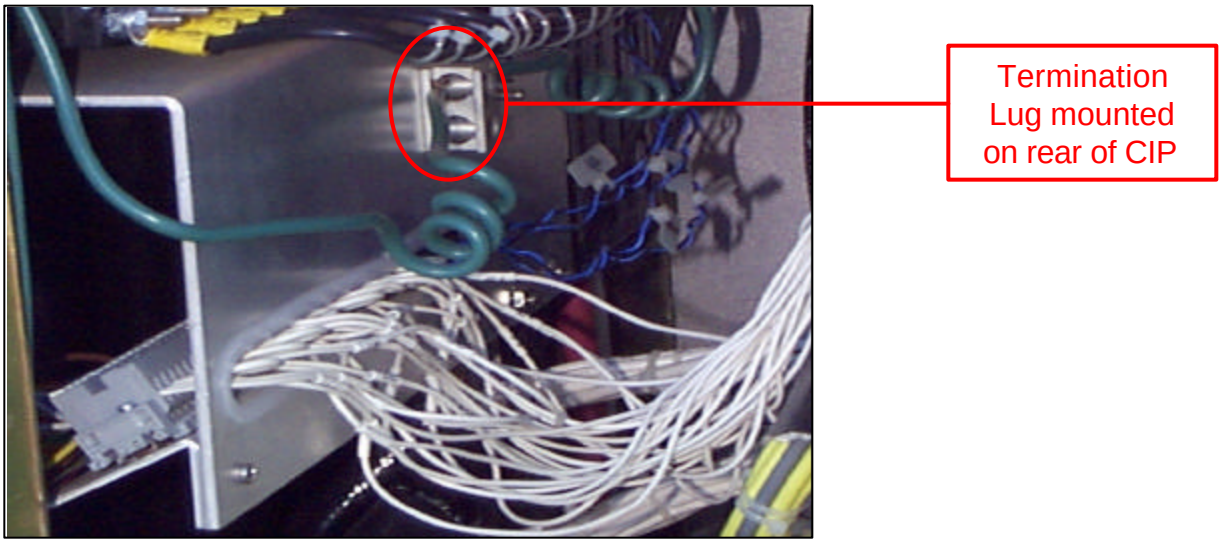


Fig. 33: Equipment Ground on Rear of CIP.

5) Verify the 44 position terminal block on front is a Phoenix Contact, Type MBK2.5/E or equal.
(TEES July 1996 - SPEC 8.4.3.8.1)

6) Verify 30 PXDA 1Pole-20A circuit breakers.
(TEES July 1996 - SPEC 8.4.3.7)

7) Verify strain relief devices are provided for incoming Harnesses #4 & #5.
(TEES July 1996 - SPEC 8.4.3.8.2)

PIXEL DRIVER ASSEMBLY (PXDA)

1) Verify dimensions of PXDA's as shown below.
(TEES July 1996 - page 8-7-4)

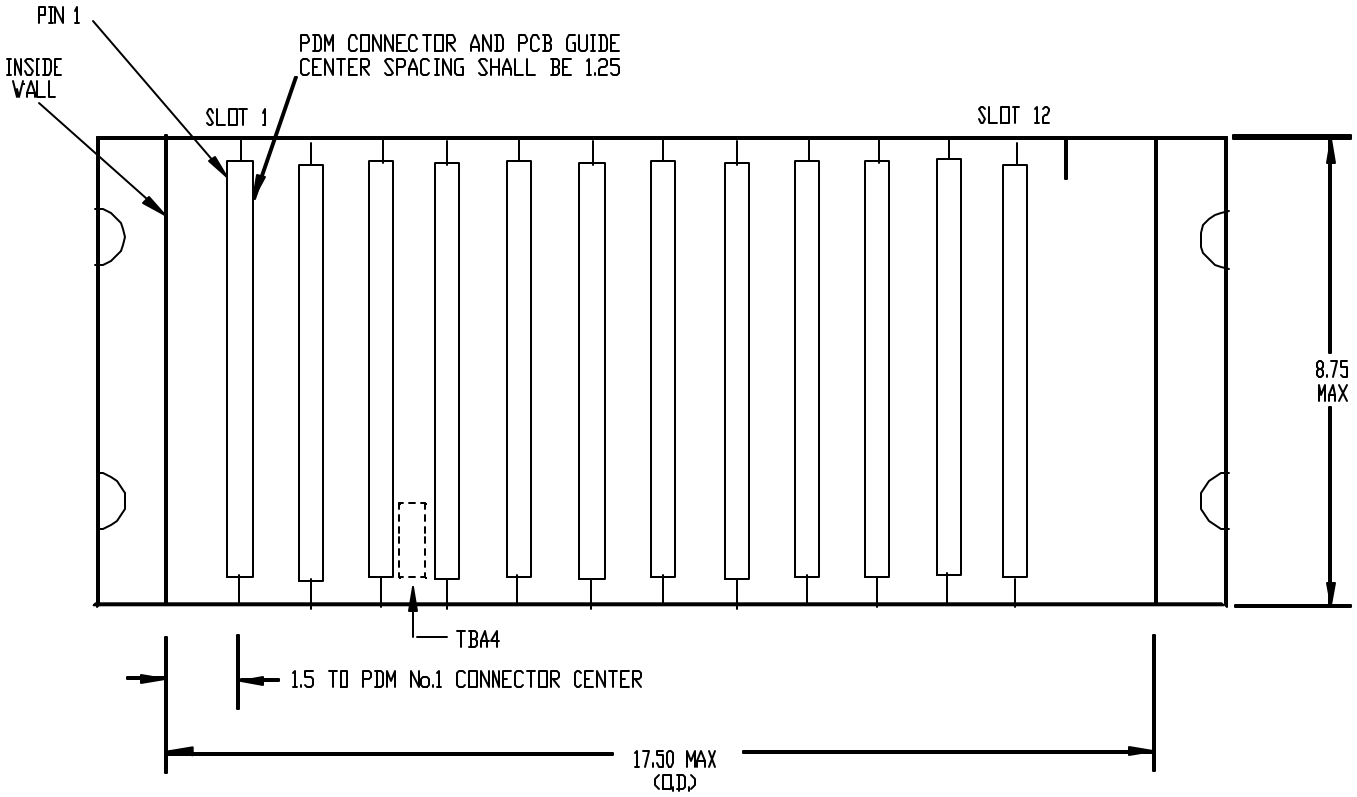


Fig. 34: PXDA Dimensions.

2) Verify there are five PXDA sets, each of which supports 12 PDM's with a proper fit. (TEES July 1996 - SPEC 8.4.5.2)

3) Verify the PXDA-PDM connectors are 43/86S PCB vertically centered and are keyed to prevent improper insertion of the PDM's. Verify guides are provided top and bottom to insert and support the PDM's. (TEES July 1996 - SPEC 8.4.5.3.3)

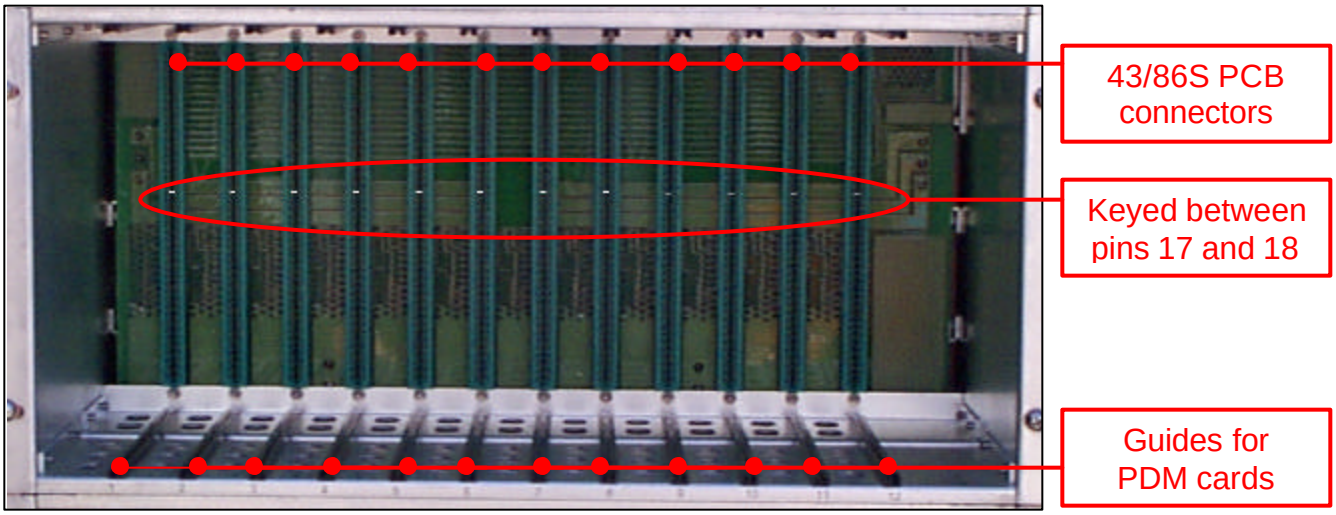


Fig. 35: Front View of PXDA with PDM Cards Removed.

4) Remove one PXDA and verify the following conditions: (TEES July 1996 - SPEC 8.4.5.3 and page 8-7-5)

a. A PCB motherboard for routing circuits to and from the PDM connectors, no jumper wires are allowed.
b. Four 3 position terminal blocks, or two 6 position terminal blocks and labeling.

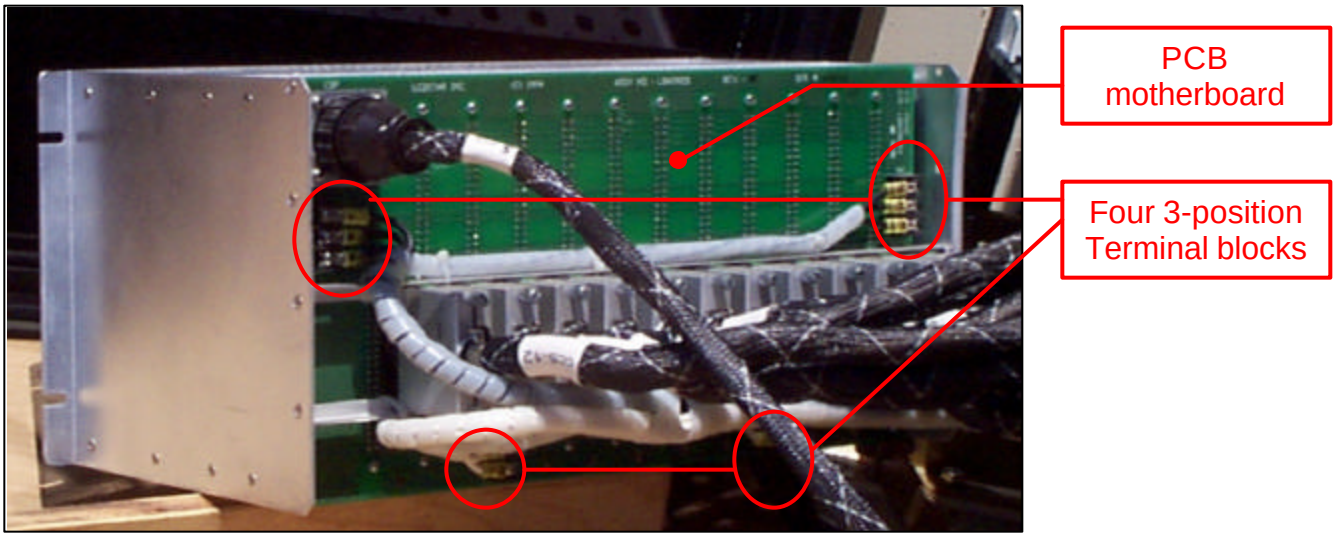


Fig. 36: Rear View of PXDA.

PIXEL DRIVER MODULES (PDM)

1) Verify dimensions as shown below.
(TEES July 1996 - page 8-7-6)

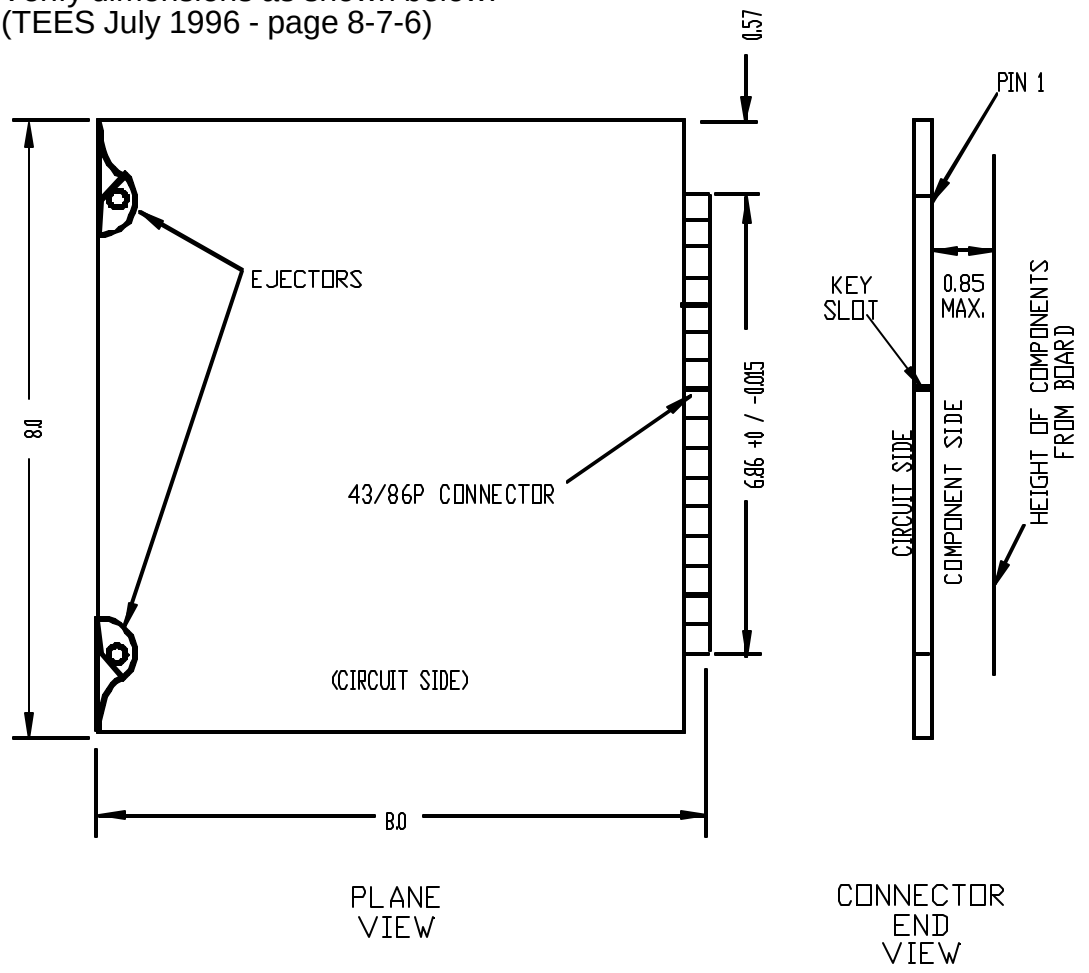


Fig. 37: PDM Dimensions.

2) Visually inspect fabrication quality of PCB and verify the following conditions:

   a. Acceptable soldering. (TEES November 18,1999 – SPEC 1.6.2)
   b. Clear of residual flux. (TEES November 18,1999 – SPEC 1.6.1.4.2)
   c. Moisture resistant coating. (TEES November 18,1999 – SPEC 1.6.1.4.4)

3) Verify PCB edge connectors are 43/86P, with key slot between pins 17 and 18.
(TEES July 1996 - SPEC 8.4.6.1.1)

4) Verify manufactured dates on electronic components provided are not more than two (2) years old from Contract award date.
(TEES November 18,1999 – SPEC 1.3.2.3)

5) Verify each module is interchangeable without modification or alteration of the module connectors and/or circuitry.
(TEES July 1996 - SPEC 8.4.6.1.2)

6) Verify PDM's are fused protected with three 5-ampere medium blow type fuses. (TEES July 1996 - SPEC 8.4.6.1.5)

7) Verify PDM's contain 40 pixel load triacs. (TEES July 1996 – SPEC 8.4.6.2.1)

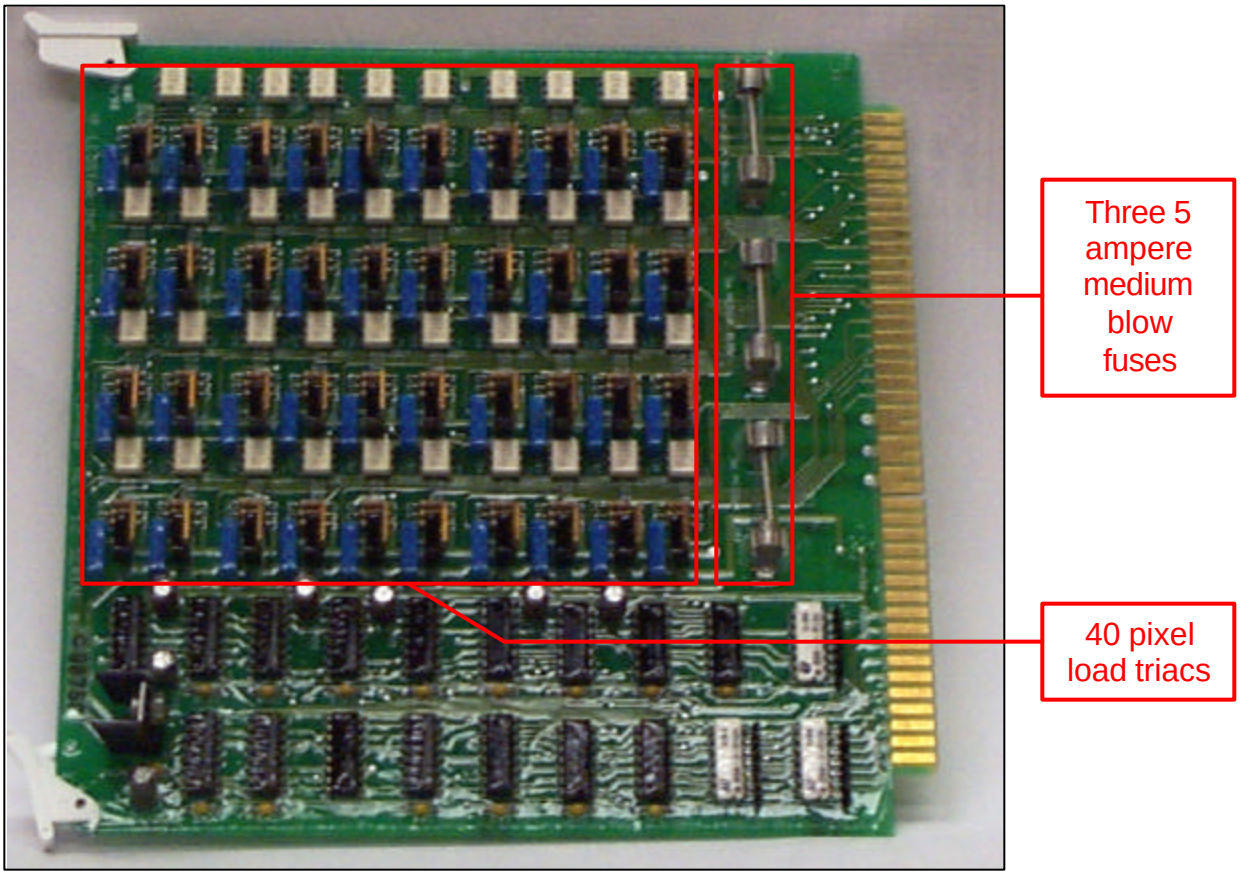


Fig. 38: Component Side of PDM Card.

8) Verify PCB components are on the left side of the board when the PDM is installed in the PXDA. (TEES July 1996 - page 8-7-6)

PIXEL MATRIX MODULE (PMM)

1) Verify each PMM is secured to the CMS housing with four TDS No.2 devices. (TEES July 1996 - SPEC 8.2.1.2)

2) Visually inspect PMM construction and materials used. Verify the following conditions:
(See figures 38 – 45)
(CMS Specification Addendum November1998 - page 8-8-5A)

a. Dimensions.
b. 40 xenon lamps, 5 high by 8 across.
c. Reflector panel can be individual for each pixel or a mold for the entire PMM.
d. Black paint or anodizing on flat surface of reflector panel, and bright silver anodizing on parabola sections.
e. Smooth surface of parabola sections, no cracks, stretch marks or dents.
f. Sealed front cover to prevent water to become in direct contact with reflector and lamp.
g. Label indicating topside of PMM.
h. Labeling of CA and CB connectors.

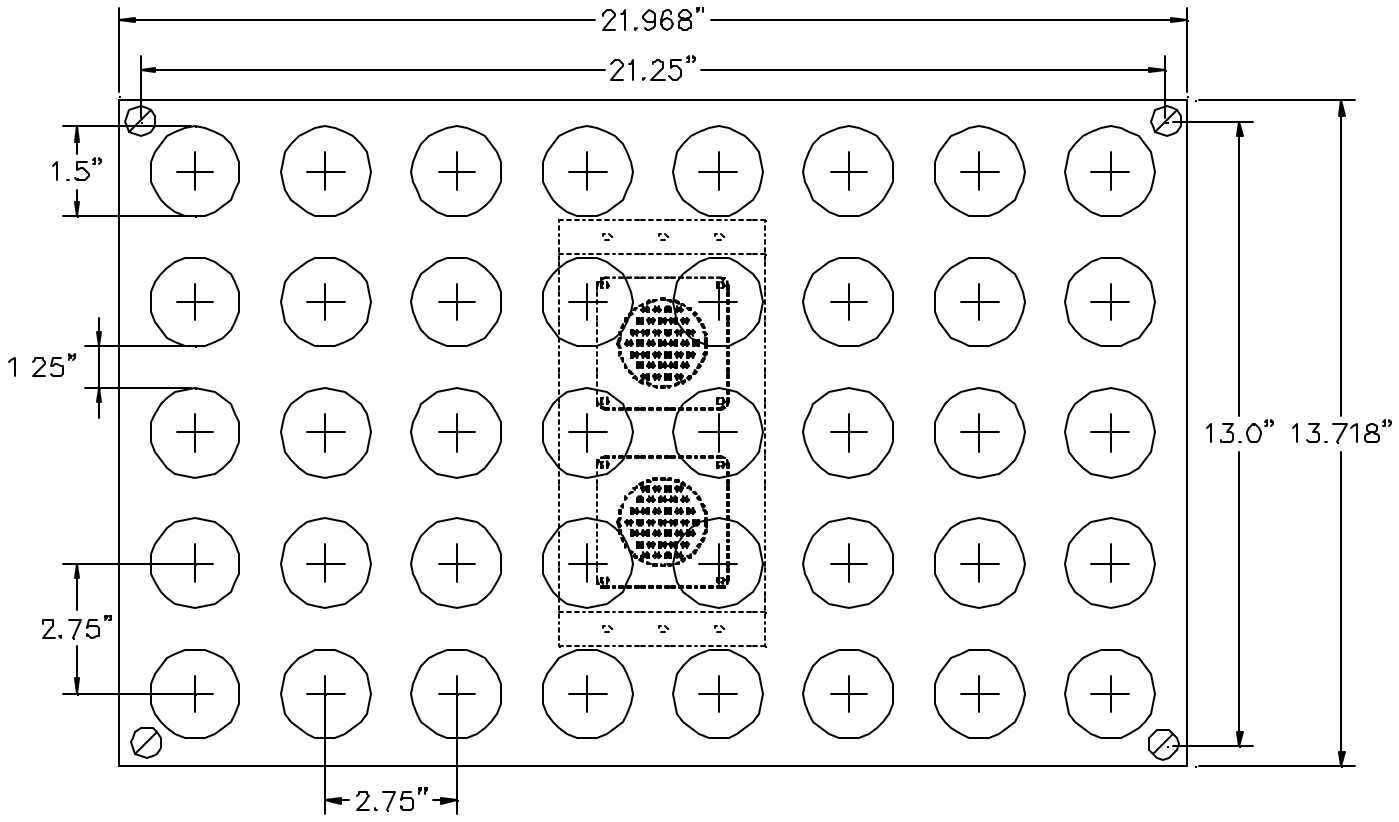


Fig. 39: Model 500 PMM Dimensions.

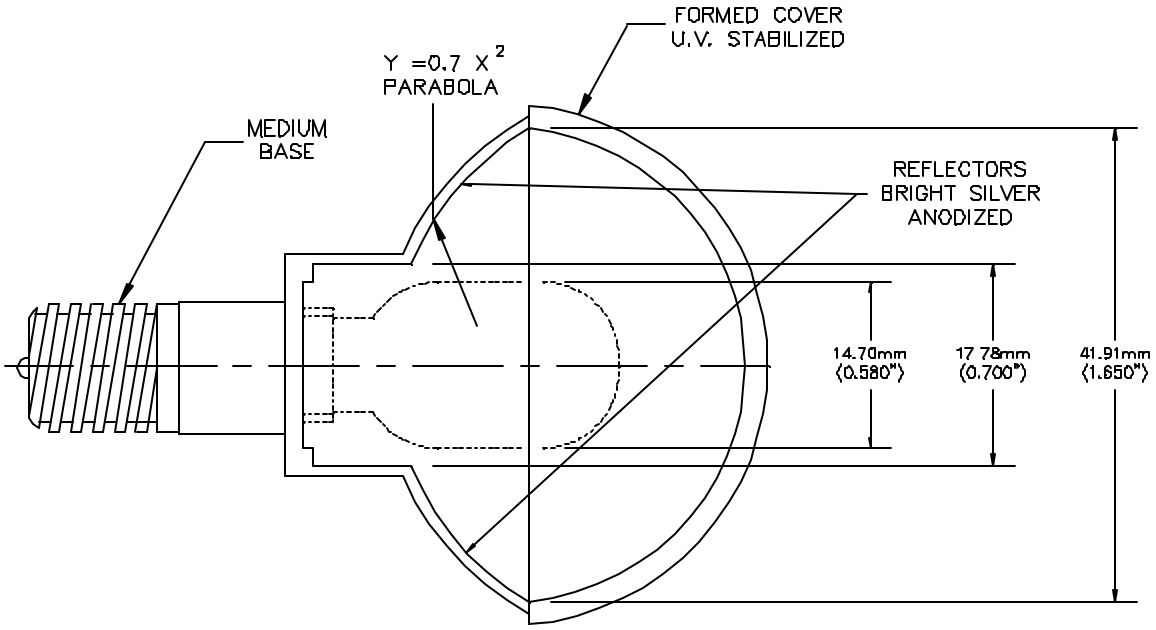


Fig. 40: Individual Reflector Panel Dimensions for Model 500 Pixel.

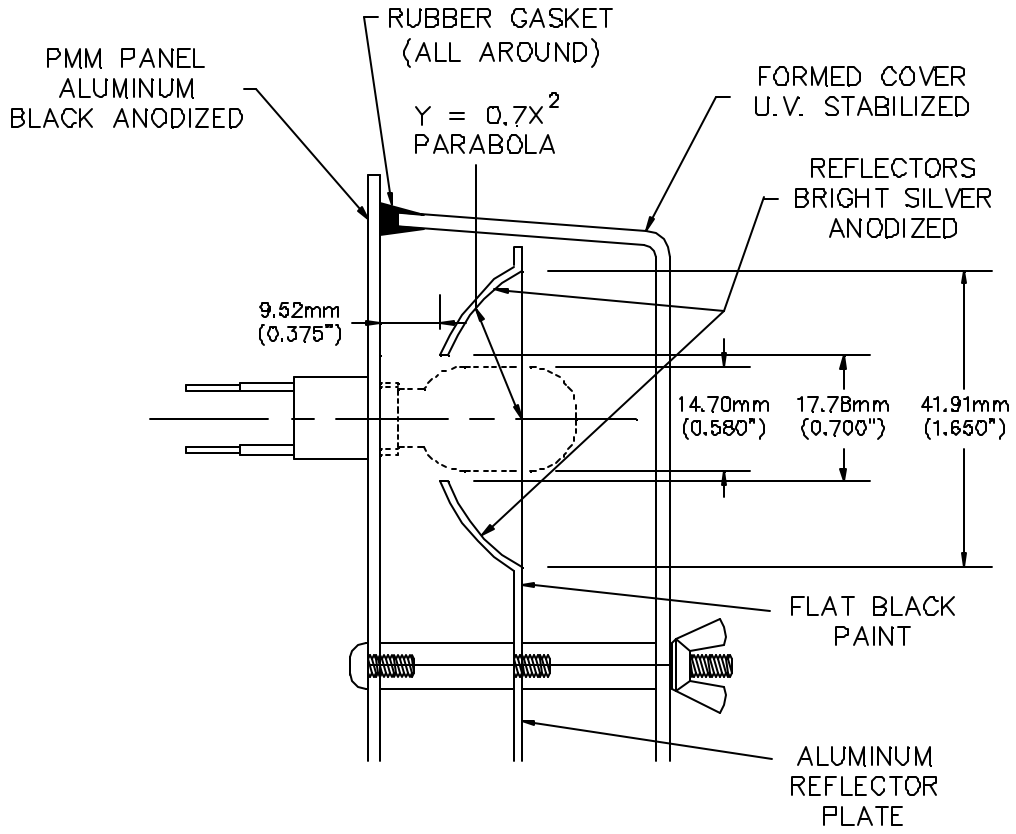


Fig. 41: Side View of Model 500 Pixel with Full Panel Molding.

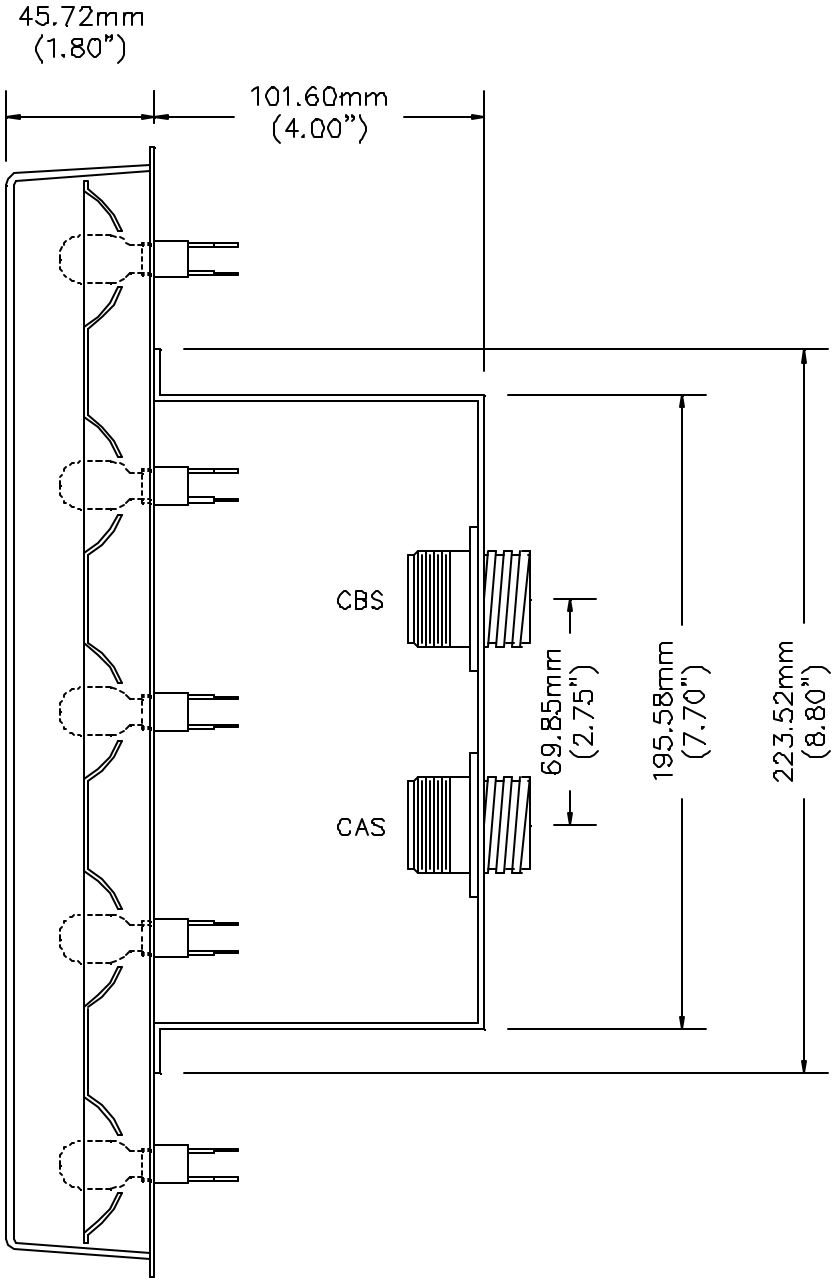


Fig. 42: Side View of Model 500 PMM with Full Panel Molding.

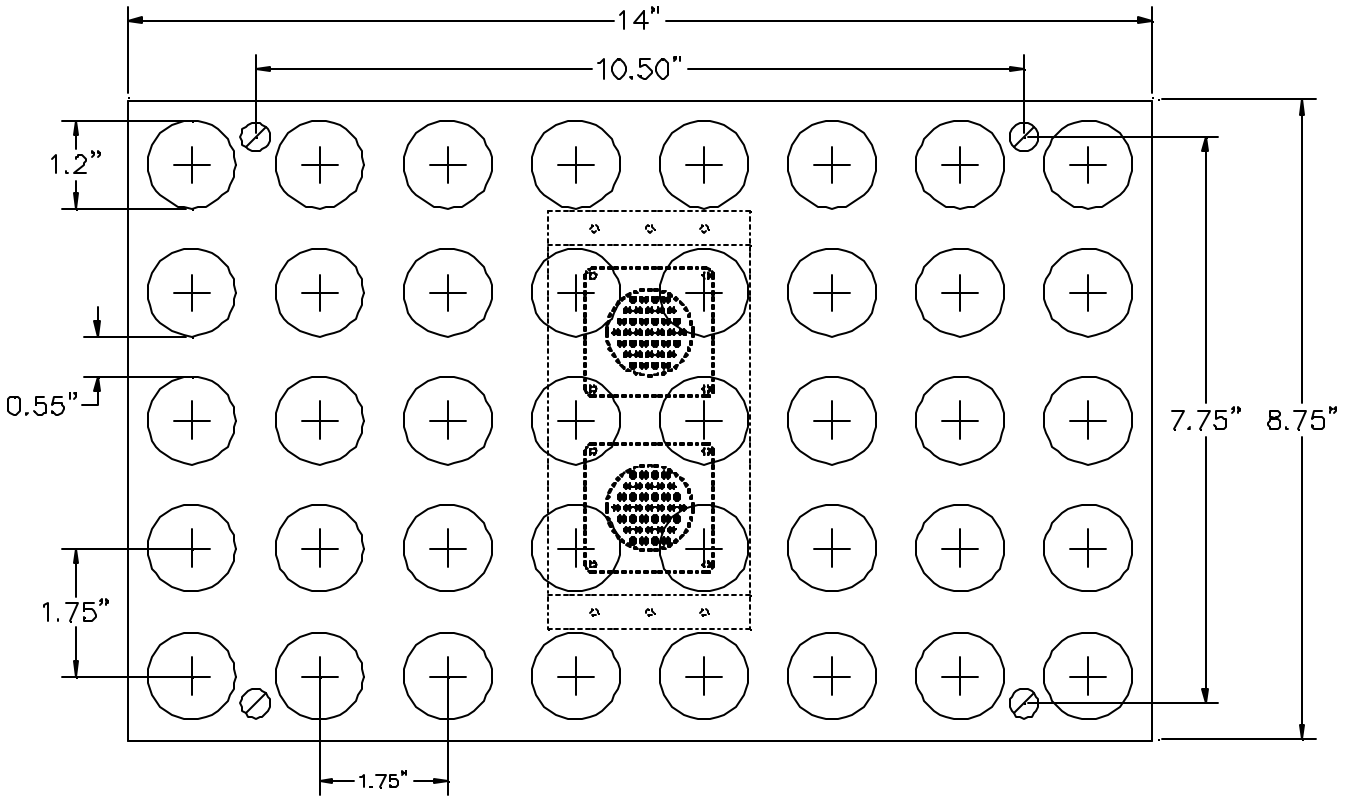


Fig. 43: Model 510 and 520 PMM Dimensions.

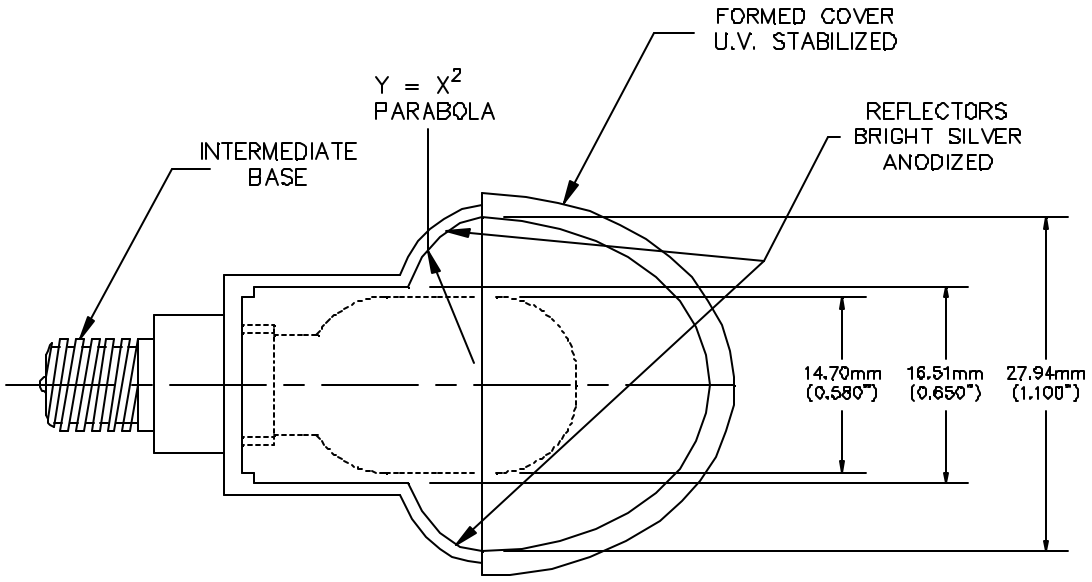


Fig. 44: Individual Reflector Panel Dimensions for Model 510 and 520 Pixel.

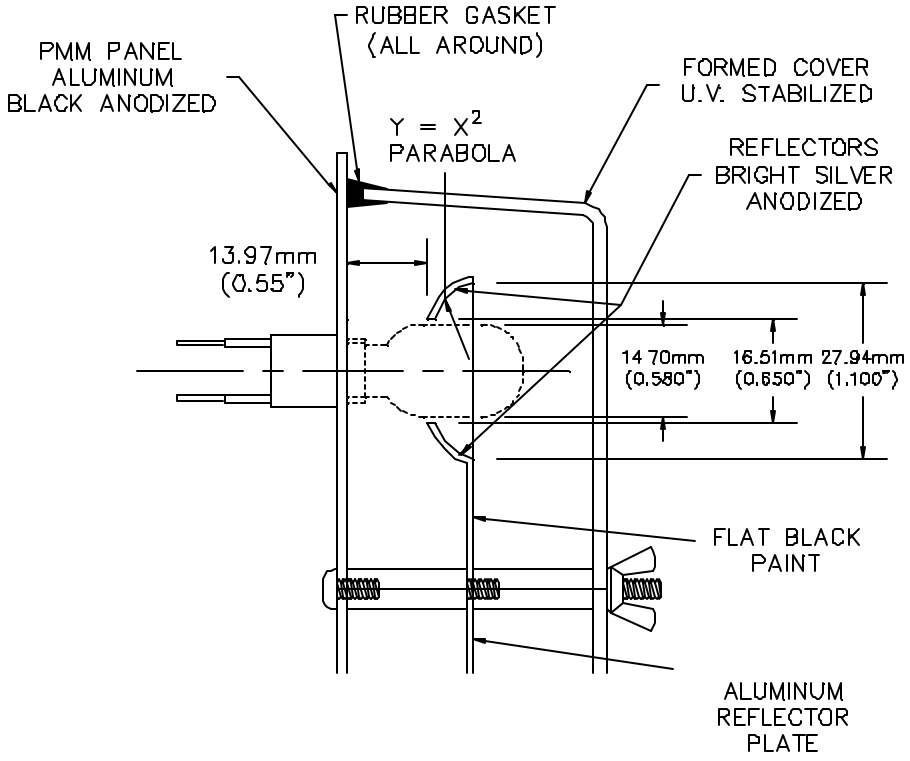


Fig. 45: Side View of Model 510 and 520 Pixel with Full Panel Molding.

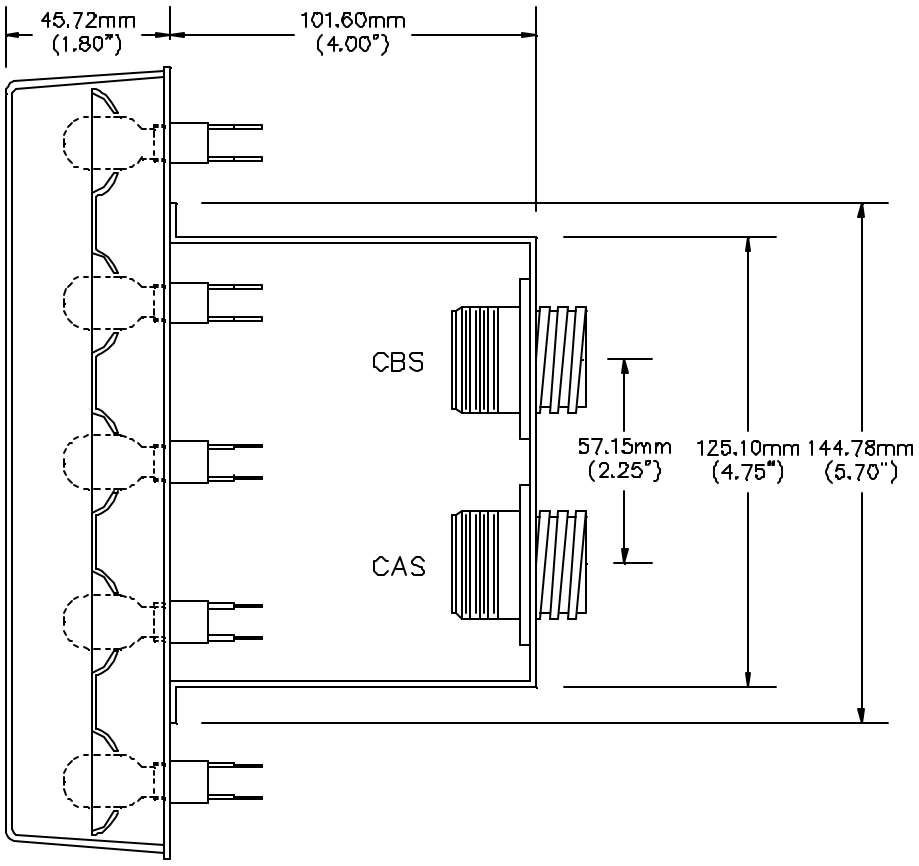


Fig. 46: Side View of Model 510 and 520 PMM with Full Panel Molding.

3) Verify xenon lamps are CHICAGO MINIATURE Type 1524X or THHC Type 2472X-2 lamps, or equal.
(CMS Specification Addendum November1998 - page 1)

4) Verify wiring is #22 AWG or larger.
(TEES July 1996 - SPEC 8.2.1.3)

5) Verify lamp sockets are brass wedge bases rated 20 watts at 28 VAC with tabs to accommodate PMM wiring. View manufacturer specifications if necessary.
(TEES July 1996 - SPEC 8.2.2.2)

6) Verify lamps and sockets are rated for outdoor usage, direct weather environment and vibration resistant. View manufacturer specifications if necessary.
(TEES July 1996 - SPEC 8.2.2.2)

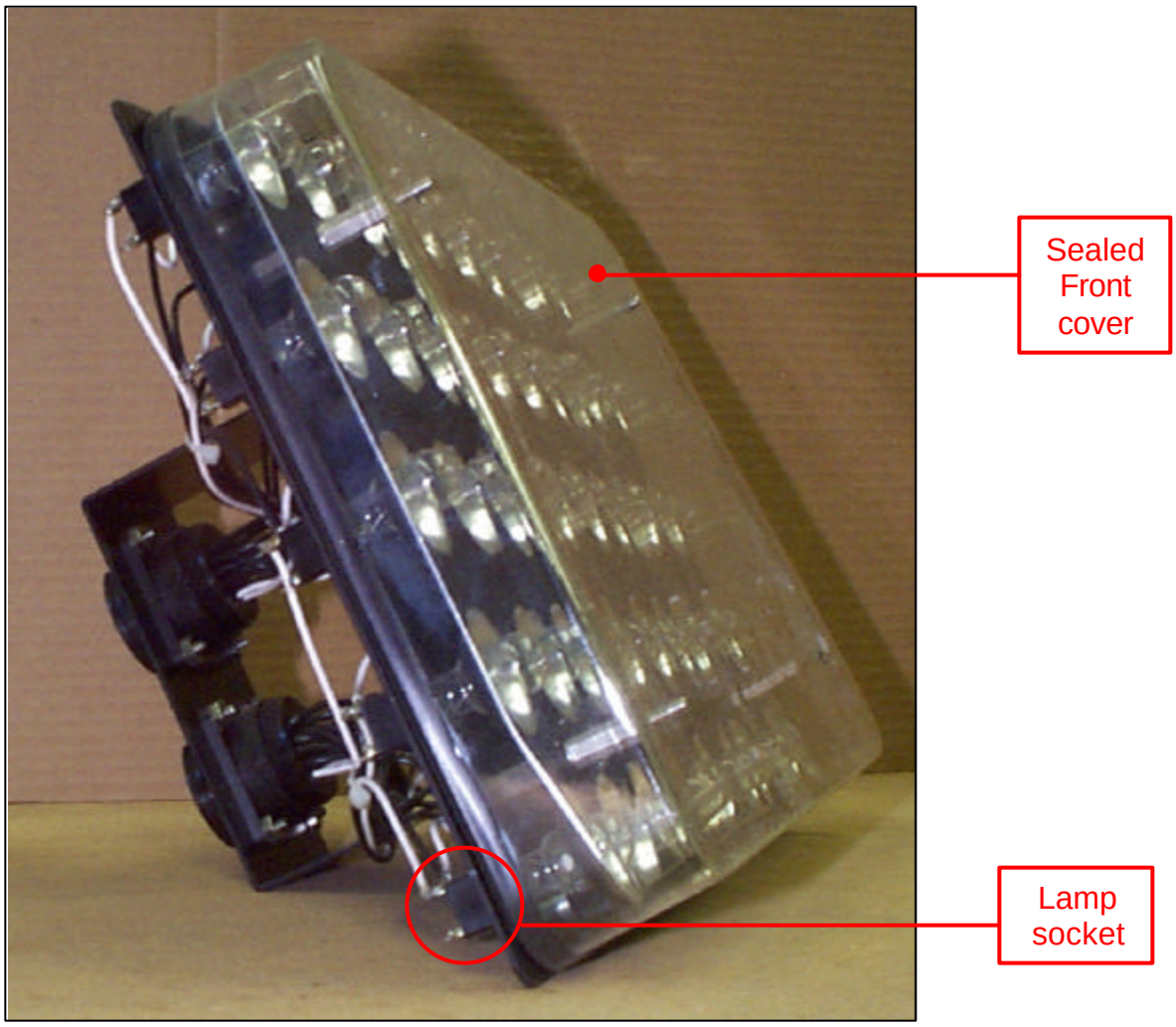


Fig. 47: Side View of Model 510 and 520 PMM.

7) Verify interchangeability of PMM's. Interchange the PMM's removed earlier, and re-install.
(TEES July 1996 - SPEC 8.2.1.1)

POWER DISTRIBUTION ASSEMBLY #4 (PDA #4)

1) Verify panel layout and labeling is correct as shown below. (TEES July 1996 - page 8-7-12)

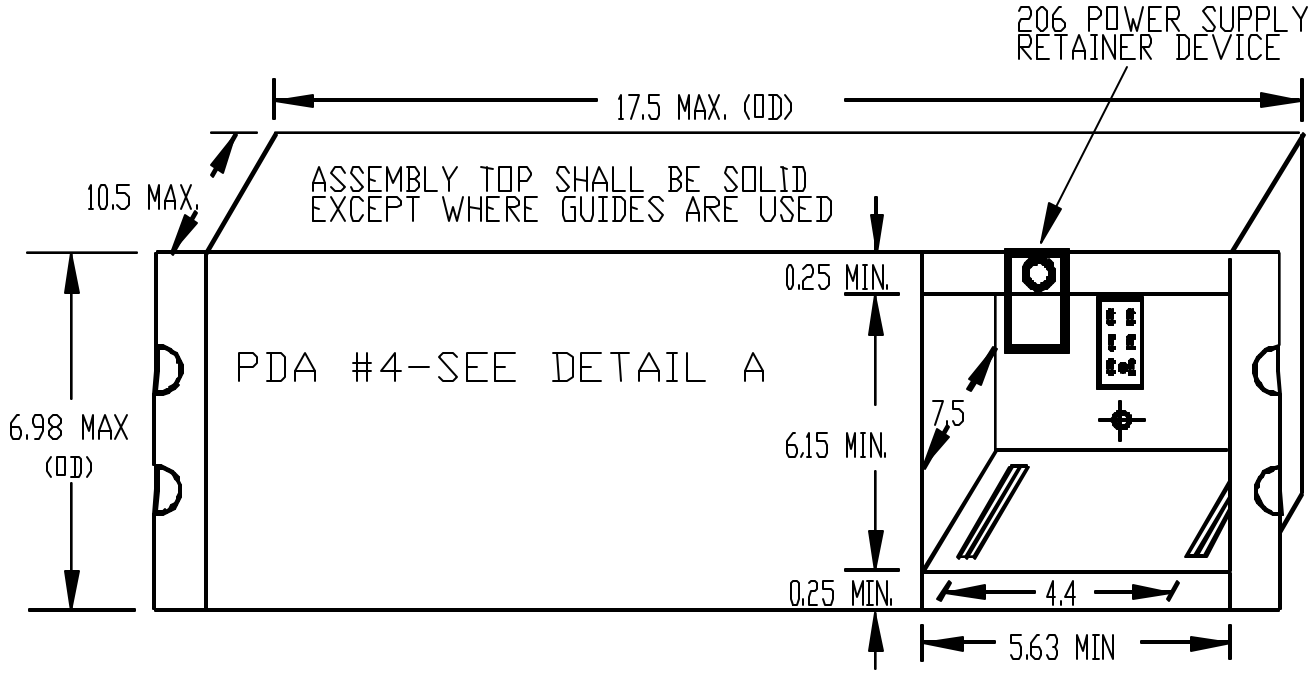


Fig. 48: PDA #4 Dimensions.

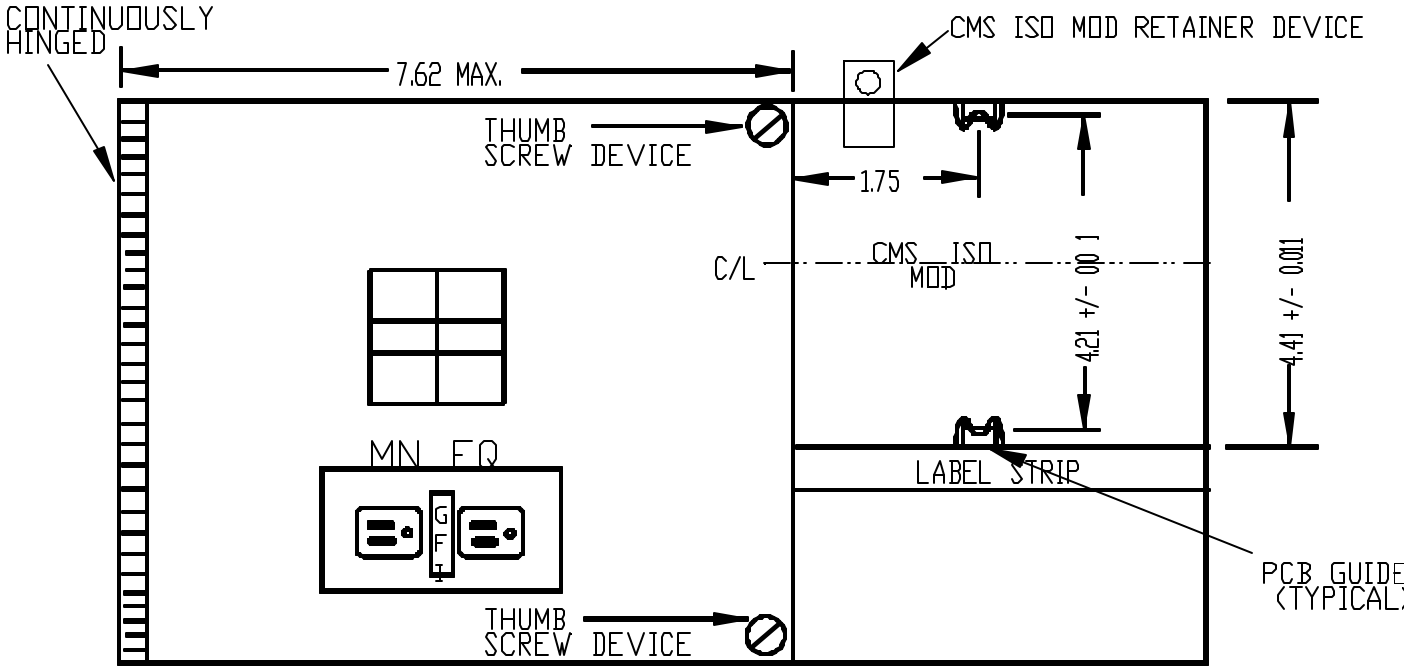


Fig. 49: PDA #4 Detail A.

2) Remove the PDA #4 and verify the following components are installed:
(TEES July 1996 - SPEC 8.4.4.1.1)

a. 1- Duplex NEMA 5-15R GFI receptacle.
b. 1- 1 Pole 15 Amp, 120VAC Equipment circuit breaker.
c. 1- 1 Pole 15 Amp, 120VAC Main circuit breaker.
d. 1- Model 206 Power Supply Module.
e. 1- 10 Position Terminal Block T2 on back
f. 1- 4 Position Terminal Block T3 on back
g. 1- CF Connector on back.
h. 5- CE Connector on back.
i. 1- CMS ISO MOD.

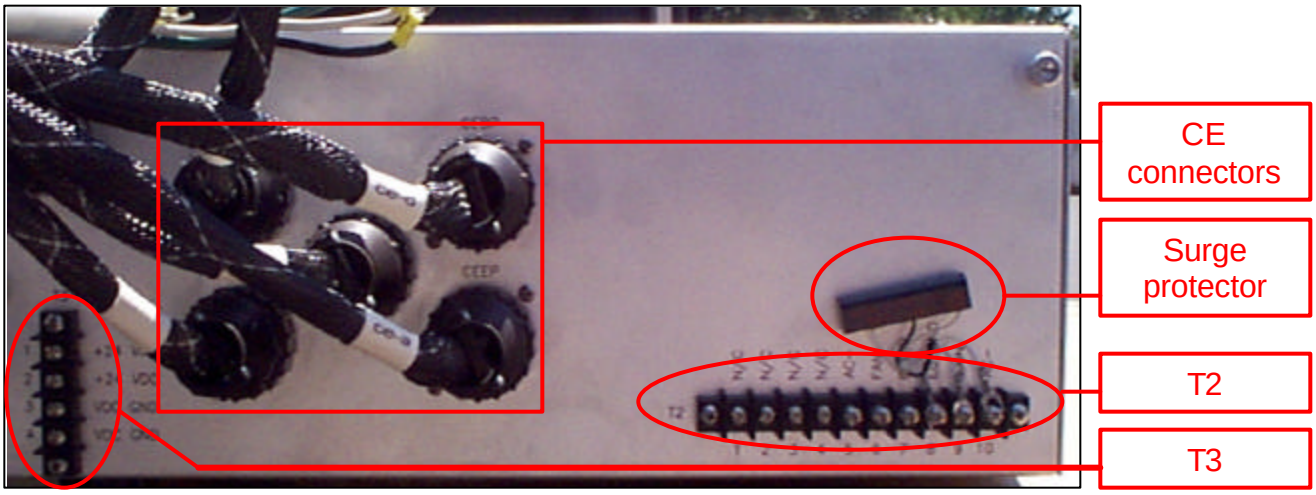


Fig. 50: Rear View of PDA #4.

3) Verify a gas tube type surge protection device is mounted externally across T2 positions 8(EGND), 9(+AC), and 10(AC-).
(TEES July 1996 - SPEC 8.4.4.4)

4) Verify mechanical retainers are installed for CMS ISO MOD and Model 206 power supply.
(TEES July 1996 - SPEC 8.4.4.1.2)

CHANGEABLE MESSAGE SIGN ISOLATION MODULE (CMS ISO MOD)

1) Verify dimensions and panel labeling is correct as shown below.
(TEES July 1996 - page 8-7-13)

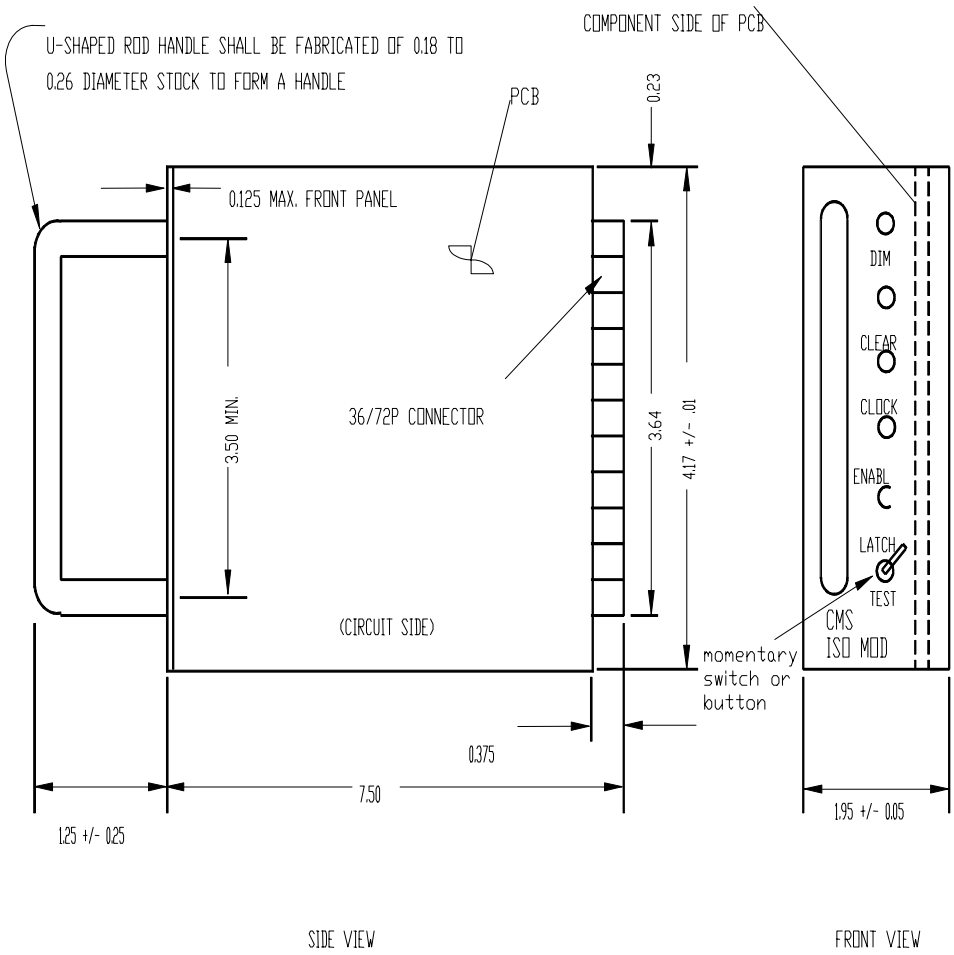


Fig. 51: CMS ISO MOD Dimensions.

2) Visually inspect fabrication quality of PCB and verify the following conditions:

   a. Acceptable soldering. (TEES November 18,1999 – SPEC 1.6.2)
   b. Clear of residual flux. (TEES November 18,1999 – SPEC 1.6.1.4.2)
   c. Moisture resistant coating. (TEES November 18,1999 – SPEC 1.6.1.4.4)

3) Verify manufactured dates on electronic components provided are not more than two (2) years old from Contract award date.
(TEES November 18,1999 – SPEC 1.3.2.3)

2) Verify PCB components are on the left side of the board when the CMS Isolation Module is installed.
(TEES July 1996 - page 8-7-13)

5) Verify test switch/button and five indicators are installed on the front panel as shown in figure 49.
(TEES July 1996 - SPEC 8.4.4.2.3)

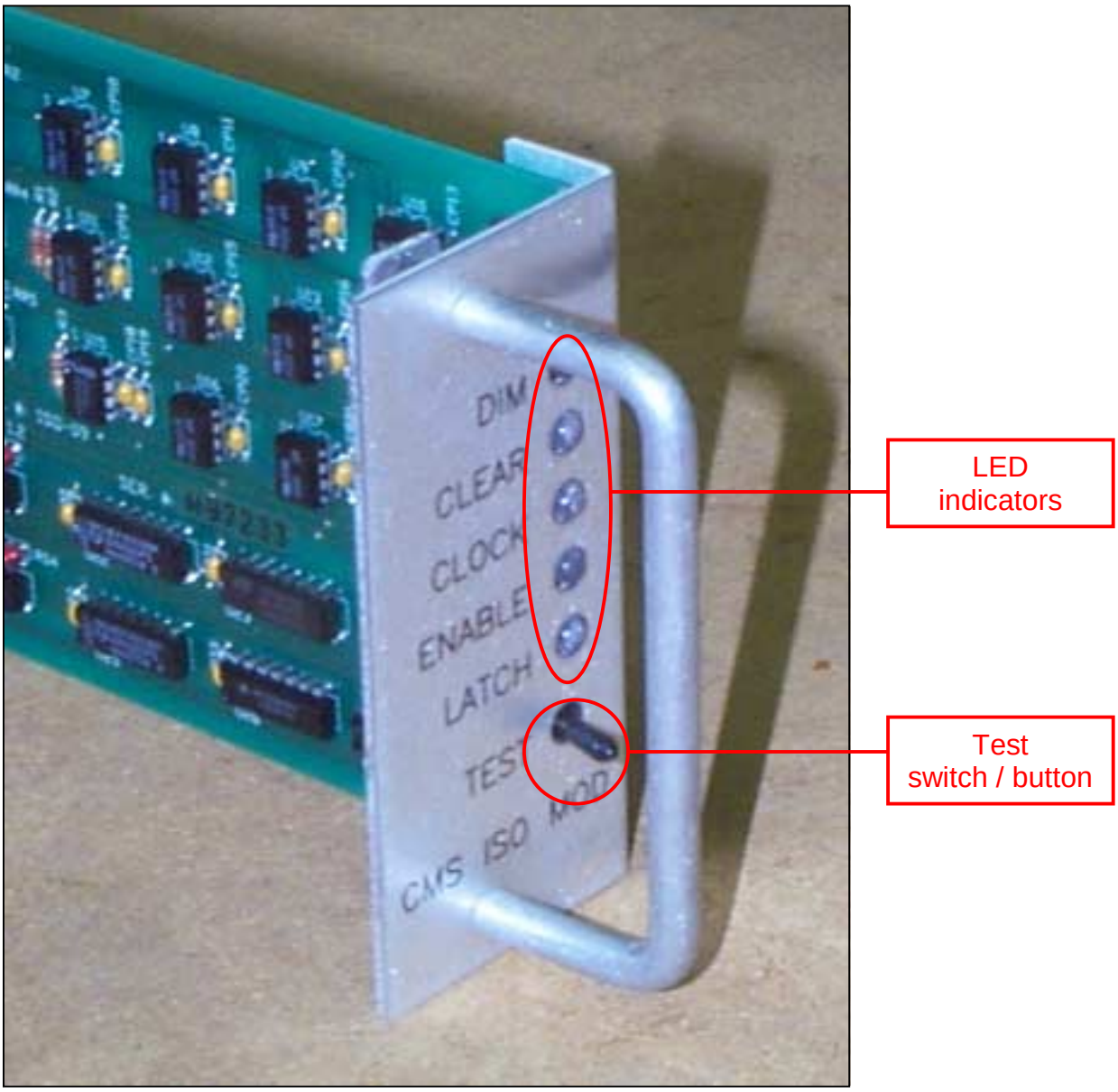


Fig. 52: CMS ISO MOD Front Panel,

TRANSFORMERS

1) Verify proper step down transformers are installed.
(CMS Specification Addendum November 1998 – page 1)

   a. Model 500 & 510 - four 5 KVA, rated 120 VAC to 20 VAC
   b. Model 520 - two 5 KVA, rated 120 VAC to 20 VAC

2) Verify manufacturer's name or logo and part number are clearly and legibly printed on the case or lamination.
(TEES November 19, 1999 – SPEC 1.3.7)

3) Verify transformer leads are color coded or identified in a manner to ensure proper installation.
(TEES November 19, 1999 – SPEC 1.3.7)

4) Verify transformers are connected between the CMS main disconnect and the 30 PXDA circuit breakers.
(CMS Specification Addendum November 1998 – page 8-8-2A)

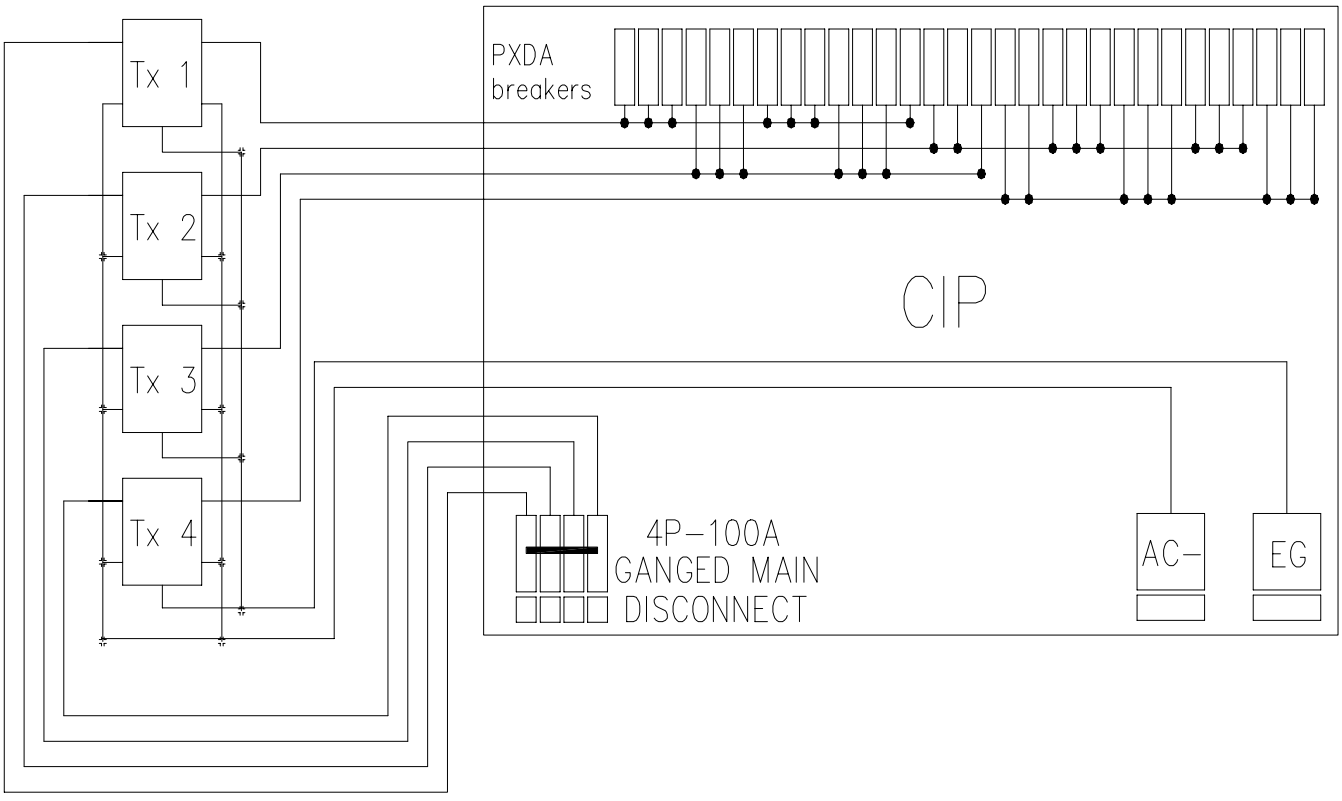


Fig. 53: Transformer connections for Model 500 & 510.

VENTILATION SYSTEM

1) Verify CMS housing has louvered vents at the following locations:
(TEES July 1996 - SPEC 8.3.4.1 & 8.3.4.3)

   a. Upper left side.
   b. Lower right side.
   c. Bottom of housing below display area.

Fig. 54: Right Side Louvered Vent.

2) Verify any and all electric fan(s) devices are contained in control compartment only.
(TEES July 1996 - SPEC 8.3.4.2)

3) Verify lower right side vent has a removable filter held in place with bottom and side brackets, and a spring loaded top clamp.
(TEES July 1996 - SPEC 8.3.4.3)

4) Verify proper filter material, McMaster-Carr Permanent washable air filter #2069K12 or equal. View manufacturer specification if necessary.
(TEES July 1996 - SPEC 8.3.4.3.4)

5) Verify fan assembly is thermostatically controlled between 33^{o} C and 65^{o} C, with manual adjustment.
(TEES July 1996 - SPEC 8.3.4.3.3)

334C CABINET

1) Visually inspect cabinet for damage or physical defects.

2) Verify housing dimensions.
(TSCES January 1989 – Plan 5)

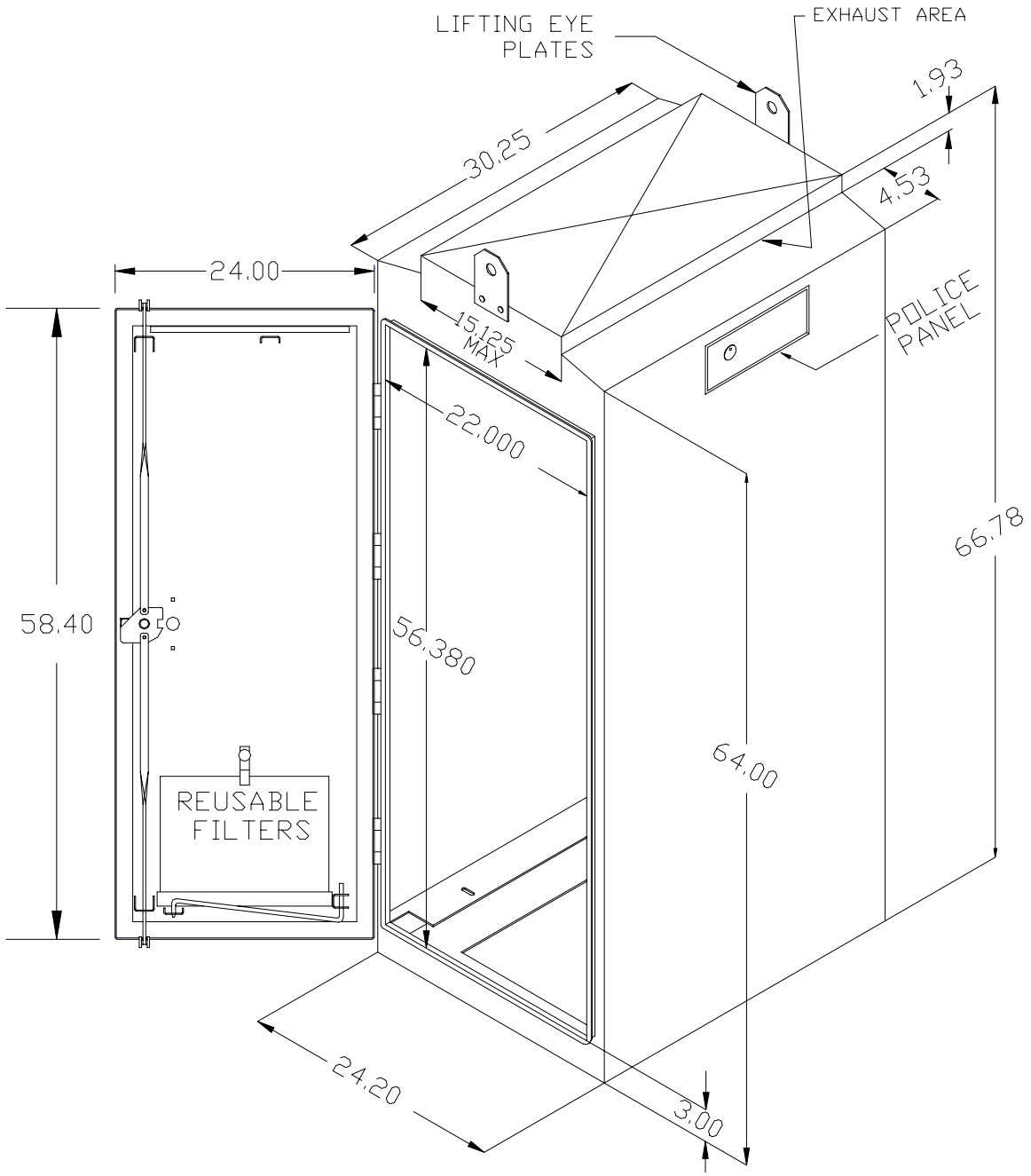


Fig. 55: 334C Cabinet Dimensions.

3) Verify proper operation of cabinet doors, locks and hinges. Doors should form a dust-tight seal when fully closed.
(TSCES January 1989 - SPEC 2.2.6)

4) Verify there are two (2) copies of each manual, two for 334C cabinet and two for CMS system. Manuals should be hanging inside 334C cabinet on the front door. Verify proper form and contents of manuals as outlined in TSCES.
(TSCES January 1989 - SPEC 1.2.2)

Fig. 56: Storage of Manuals Inside 334C Cabinet.

5) Verify the following components are installed:
(TEES July 1996 - SPEC 8.6.1)

a. Thermostatically controlled fan assembly
b. Photo Cell Assembly
c. Terminal block TB1
d. Terminal block TB2
e. Two (2) CIA's
f. Input file
g. PDA #3

6) Verify correct labeling of terminal blocks TB1 and TB2 as shown on the following pages.
(TEES July 1996 - pages 8-7-8 & 8-7-9)

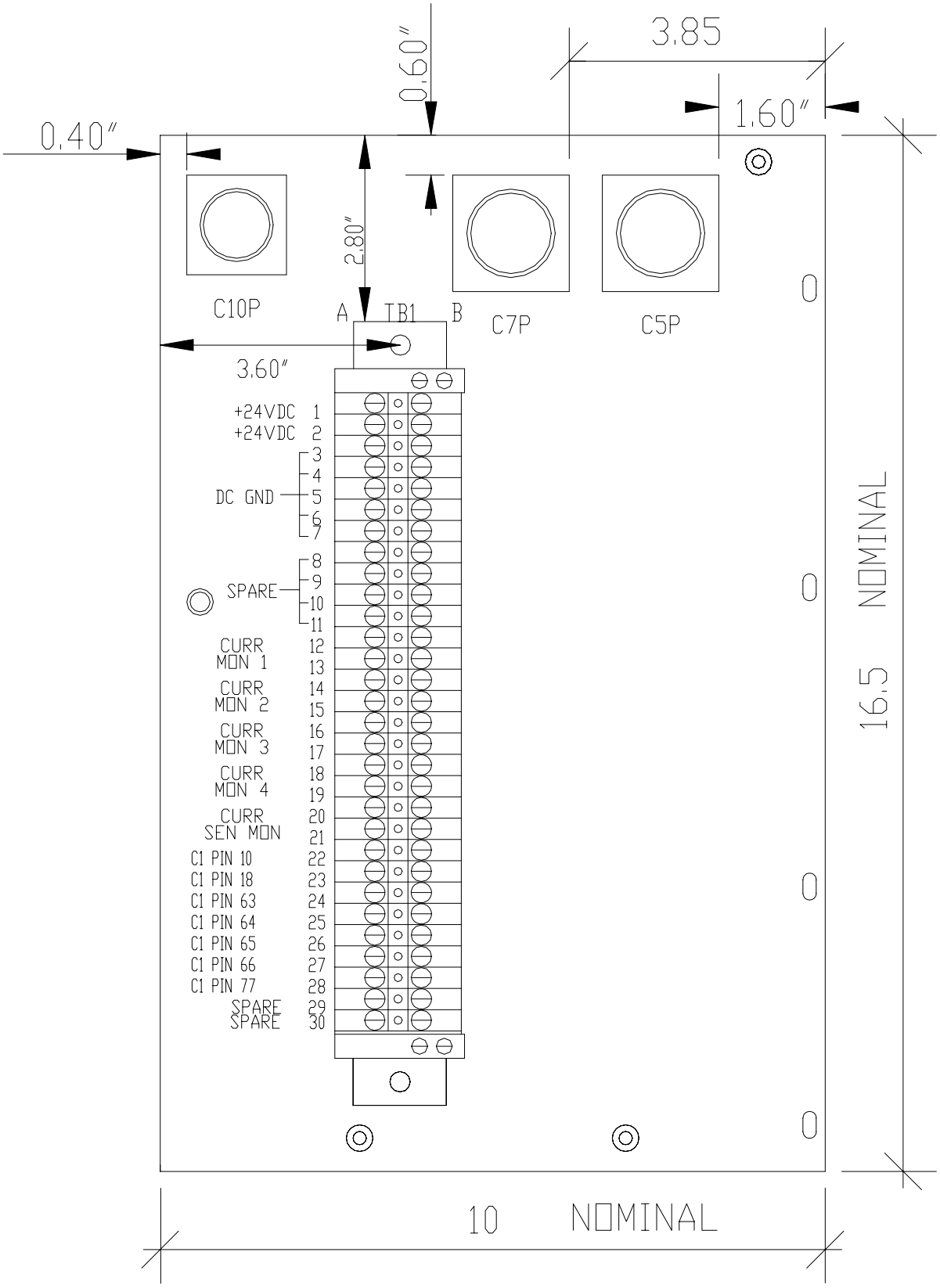


Fig. 57: Labeling of TB1.

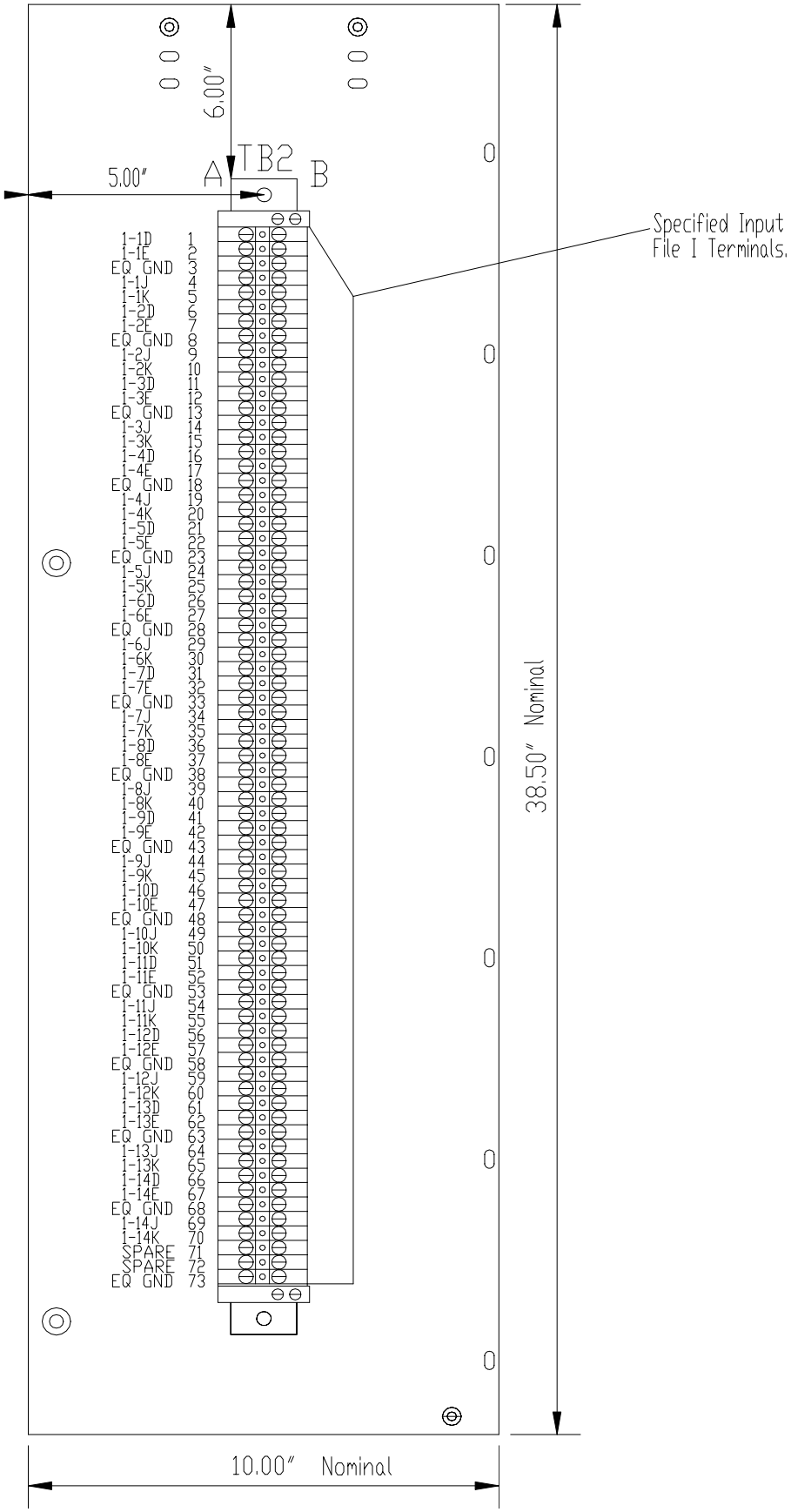


Fig. 58: Labeling of TB2.

PHOTO-ELECTRIC SENSOR ASSEMBLY

1) Verify correct type of photo-electric sensor. View manufacturer specifications if necessary.
(TEES July 1996 - SPEC 8.6.2.2.1.1 & 8.6.2.2.1.2)

2) Verify sensor has a 1.00 square inch glass window area to assure full exposure of photocell.
(TEES July 1996 - SPEC 8.6.2.2.1.4)

Fig. 59: Example of Photo-Electric Sensors.

3) Inspect connection of photo-electric sensor. Verify output lines are connected to TB1 at positions #20 and #21 inside 334C cabinet.
(TEES July 1996 - SPEC 8.6.2.2.1.5)

CHANGEABLE MESSAGE SIGN CONTROL ISOLATION ASSEMBLY (CIA)

1) Verify proper dimensions and labeling.
(TEES July 1996 – page 8-7-7)

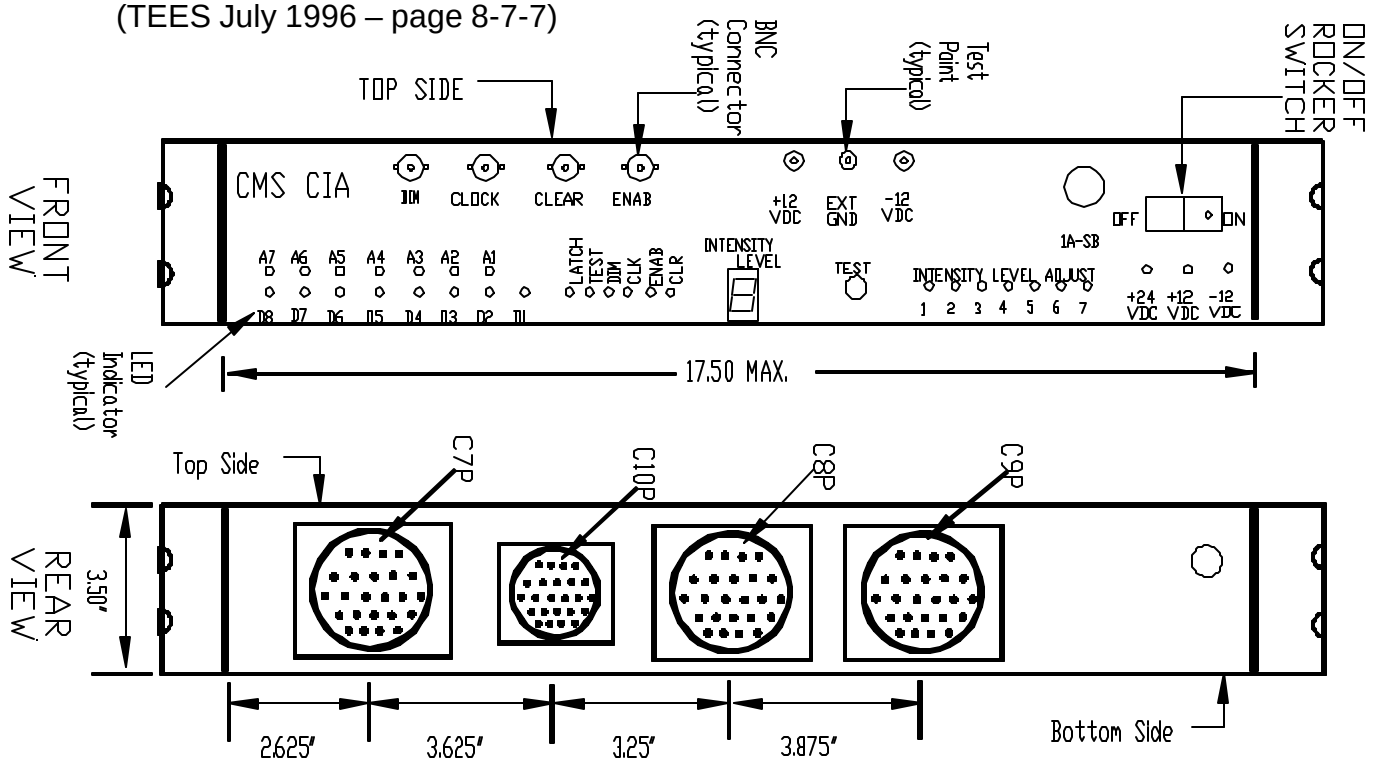


Fig. 60: CIA Dimensions.

2) Verify if a one-amp fuse is provided.

3) Verify the required BNC connectors and Test Points are provided, and labeled correctly,
(TEES July 1996 – page 8-7-7)

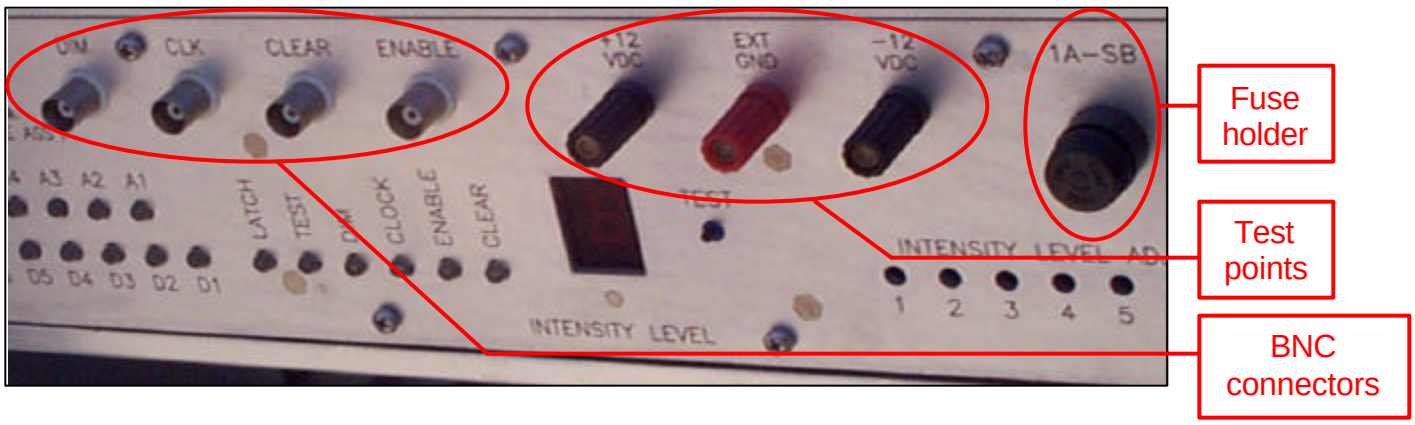


Fig. 61: CIA Front Panel.

POWER DISTRUBUTION ASSEMPLY #3 (PDA #3)

1) Verify dimensions and labeling is correct as shown below.
(TSCES January 1989 – Plan 7)

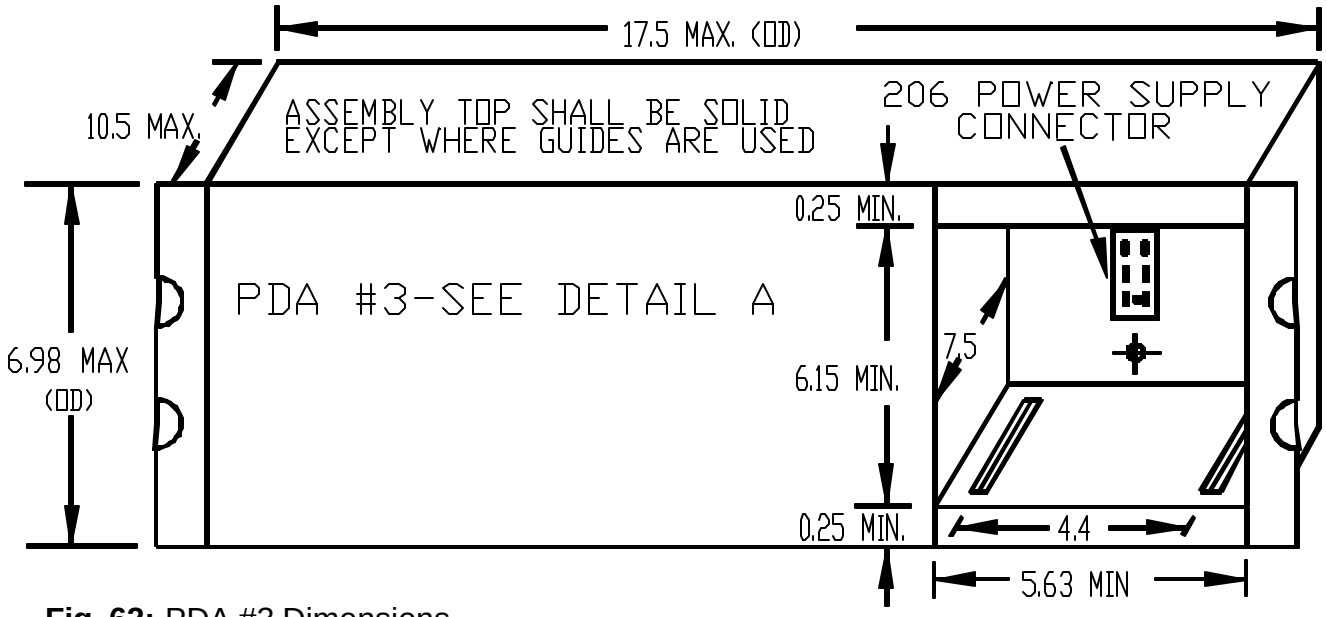


Fig. 62: PDA #3 Dimensions.

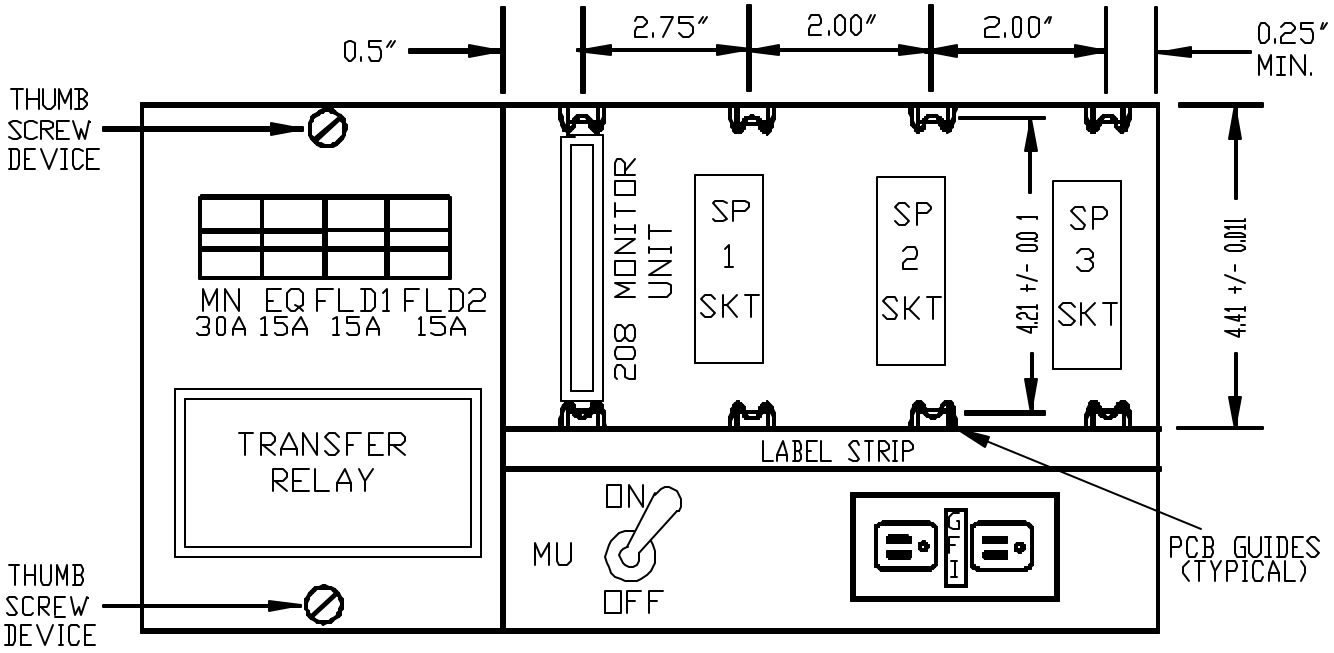


Fig. 63: PDA #3 Detail A.

2) Verify the following components are installed:

a. 1 - 1 pole 30 Amperes, 120 VAC Main circuit breaker
b. 3 - 1 pole 15 Amperes, 120 VAC circuit breaker (Equip, Field 1 & Field 2)
c. 1 - Model 208 Monitor Unit
d. 1 - Model 206 Power Supply
e. 1 - Model 430 heavy duty relay
f. 3 - Model 200 Switch Pack sockets
g. 1 - Duplex NEMA 5-15R Equipment receptacle with GFI
h. 1 - Duplex NEMA 5-15R Controller receptacle on back
i. 1 - Duplex NEMA 5-15R Equipment receptacle on back
j. 3 - 10 position terminal blocks (T1, T2 & T4) on back
k. 1 - 4 position terminal block (T3) on back

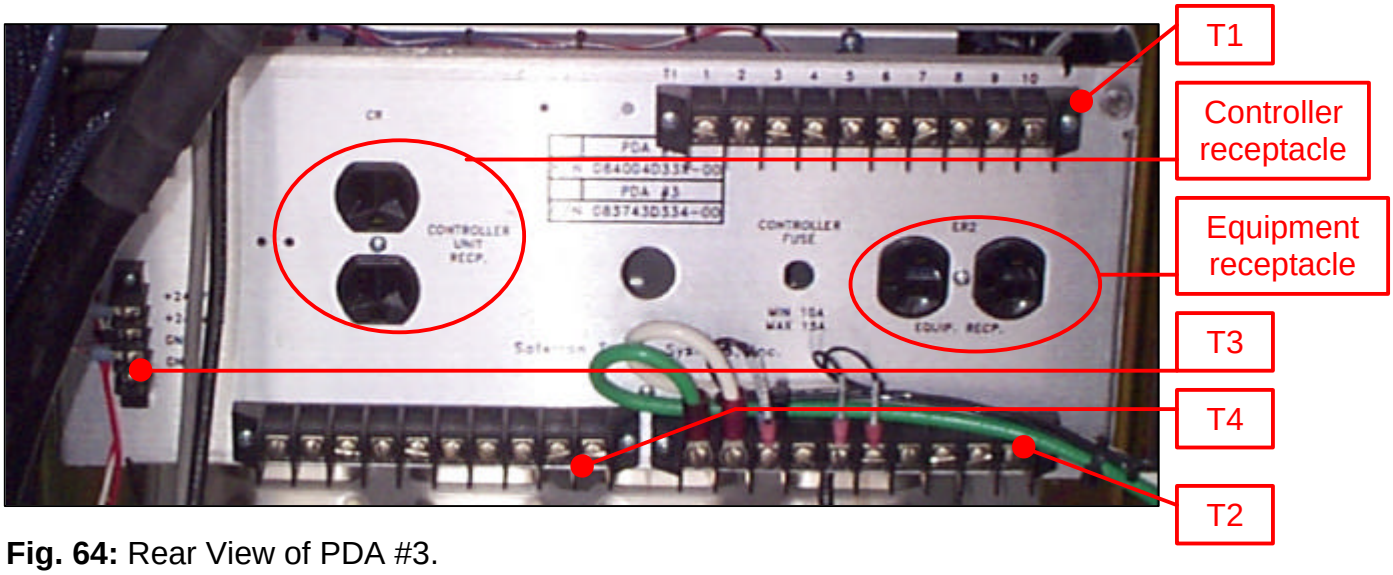


Fig. 64: Rear View of PDA #3.

QUALITY ASSURANCE AND TESTING GUIDELINES FUNCTIONAL TESTING

PREPARE CMS TO BE TESTED

1) To prepare CMS system for testing, make sure all components of the CMS system are present:

   a. 1 - 334C Cabinet with 170E controller and 2 CIA's
   b. 1 - Changeable Message Sign (CMS)
   c. 1 - Harness #4
   d. 1 - Harness #5

2) Place 170E controller into the 334C cabinet. Plug 170E power cord into Controller Unit Receptacle on back of PDA #3. Connect C1 connector from C1 harness to back of 170E.

3) Disconnect C7 and C10 connectors mounted above TB1 inside 334C cabinet (backside, upper left-hand corner). Then connect C7 and C10 connectors to C7 and C10 receptacles on back of CIA.

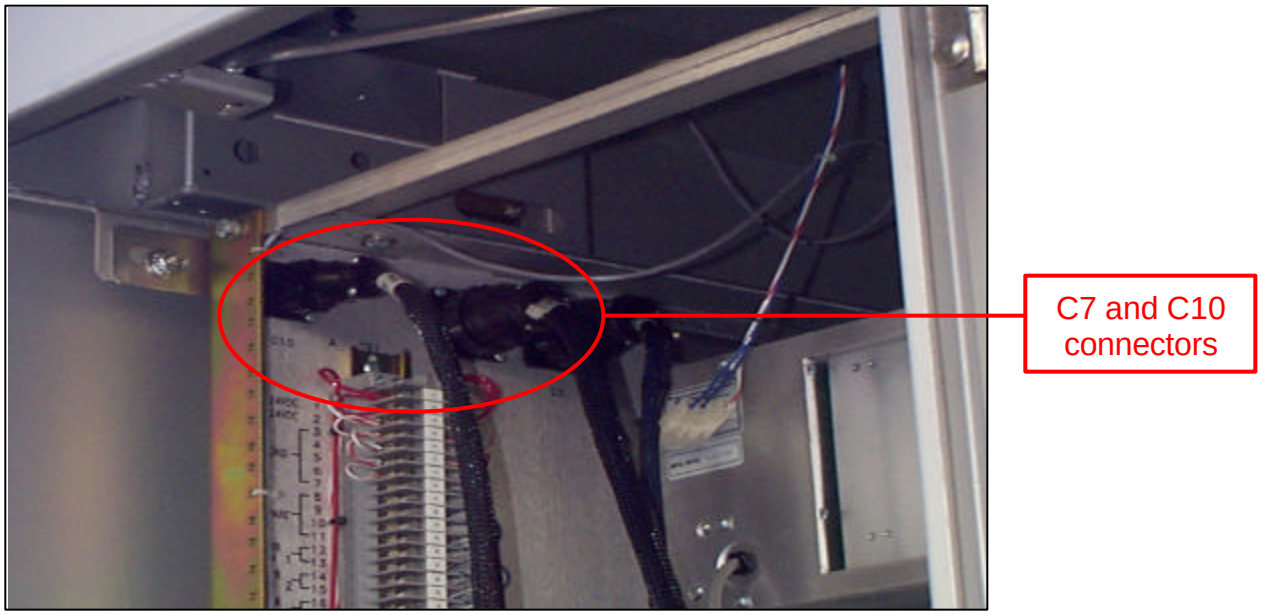


Fig. 65: Upper Rear View of 334C Cabinet.

4) Plug CIA power cord into Controller Unit Receptacle on back of PDA #3.

5) Connect harness #4, C8 and C9 connectors to C8 and C9 receptacles on back of CIA, through the back door of 334C cabinet.

6) Feed opposite end of Harness #4, with out connectors, through bottom of CMS control compartment and wire to 44 position terminal block on front of CIP.

7) Connect harness #5, side A to 44 position terminal block on front of CIP, and side B to TB1 inside 334C cabinet. Use the following wiring list:

HARNESS #5 - COLOR CODED WIRING LIST

SIDE A	CMS CONTROL COMPARTMENT CITB TERMINAL BLOCK POSITION
Pair 2 & 3	
Black	2
Red	3
Pair 4 & 5	
Black	4
White	5
Pair 6 & 7	
Black	6
Green	7
Pair 8 & 9	
Black	8
Blue	9
Unlabeled	
Black	N/A (spare)
Brown	N/A (spare)
Yellow	N/A (spare)
Black	N/A (spare)

HARNESS #5 - COLOR CODED WIRING LIST

SIDE B	334C CABINET TB1 POSITION
Pair 12 & 13	
Black	12 CURR
Red	13 MON 1
Pair 14 & 15	
Black	14 CURR
White	15 MON 2
Pair 16 & 17	
Black	16 CURR
Green	17 MON 3
Pair 18 & 19	
Black	18 CURR
Blue	19 MON 4
Unlabeled	
Black	N/A (spare)
Brown	N/A (spare)
Yellow	N/A (spare)
Black	N/A (spare)

Fig. 66: Harness #5 wiring list.

8) Remove 412C module from 170E controller. Remove DAT EPROM from U1 socket and replace with Signveiw EPROM. Re-install 412C module.

9) On 412C module set LOCATION dip switches for sign number, and FEATURE dip switches for field source, and leased-line communication as shown below:
(Note – illustration below shows LOCATION setting for TransLab' test CMS)

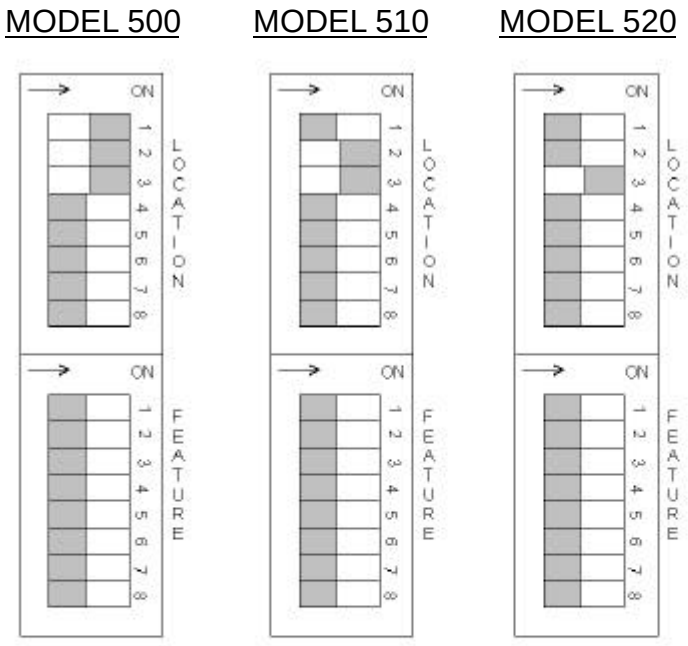


Fig. 67: Dip Switch Settings.

10) Verify all breakers in CMS and 334C cabinet are turned off.

11) Verify the STOP TIME toggle switch on the 170E controller is in the OFF position.

12) Plug a suicide cord from the ER2 Equipment Receptacle on back of the PDA #3 (inside 334C cabinet) to the GFI receptacle on the PDA #4 (inside CMS control compartment).

13) Power source should be 120/240 VAC single phase, with 100 amp minimum circuit breaker. Verify all circuit breakers in electrical panel box are turned off before hooking up to CMS.

14) Feed power cable through the bottom of CMS control compartment. Power wires are connected to main disconnect on CIP, Green wire is connected to the equipment ground which is tied to the frame, and White wire is connected to neutral.

15) If only two power wires are available, connect one to L1 and the other to L3 of the CMS main disconnect. Then use jumpers to connect L1/L2 and L3/L4 (As shown in figure 64).

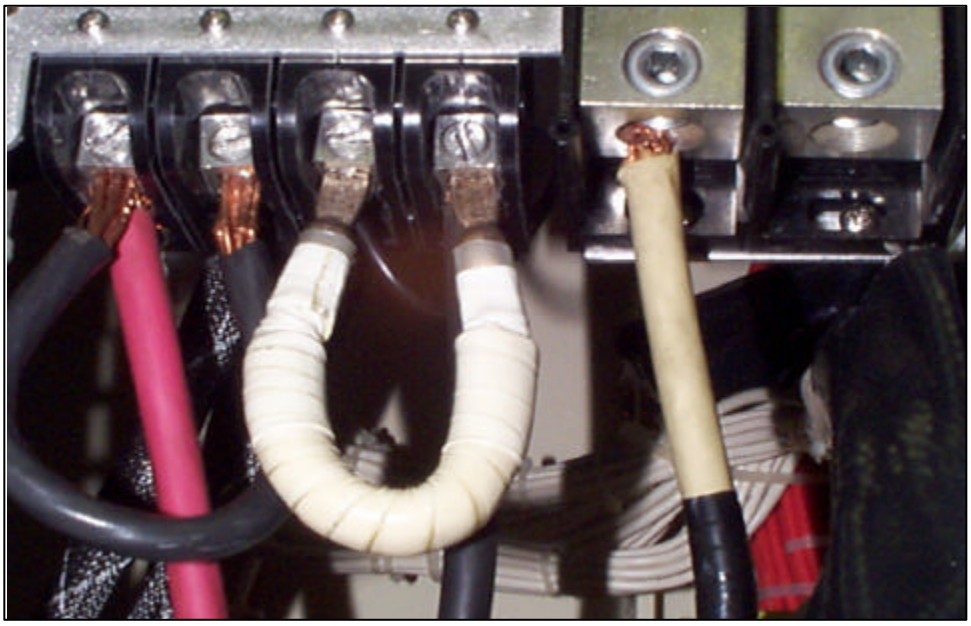


Fig. 68: CMS Main Power Connection.

16) If four power wires are available, do not use jumpers. Instead, each wire is connected to a different leg on main disconnect.

In some cases, the manufacturers will have the CMS systems set-up and ready for functional testing. If this is the case, all connections should be double-checked before turn-on. On the following pages, figures 67, 68, 69 and 70 have been given as a quick reference guide to verify the set-up is complete.

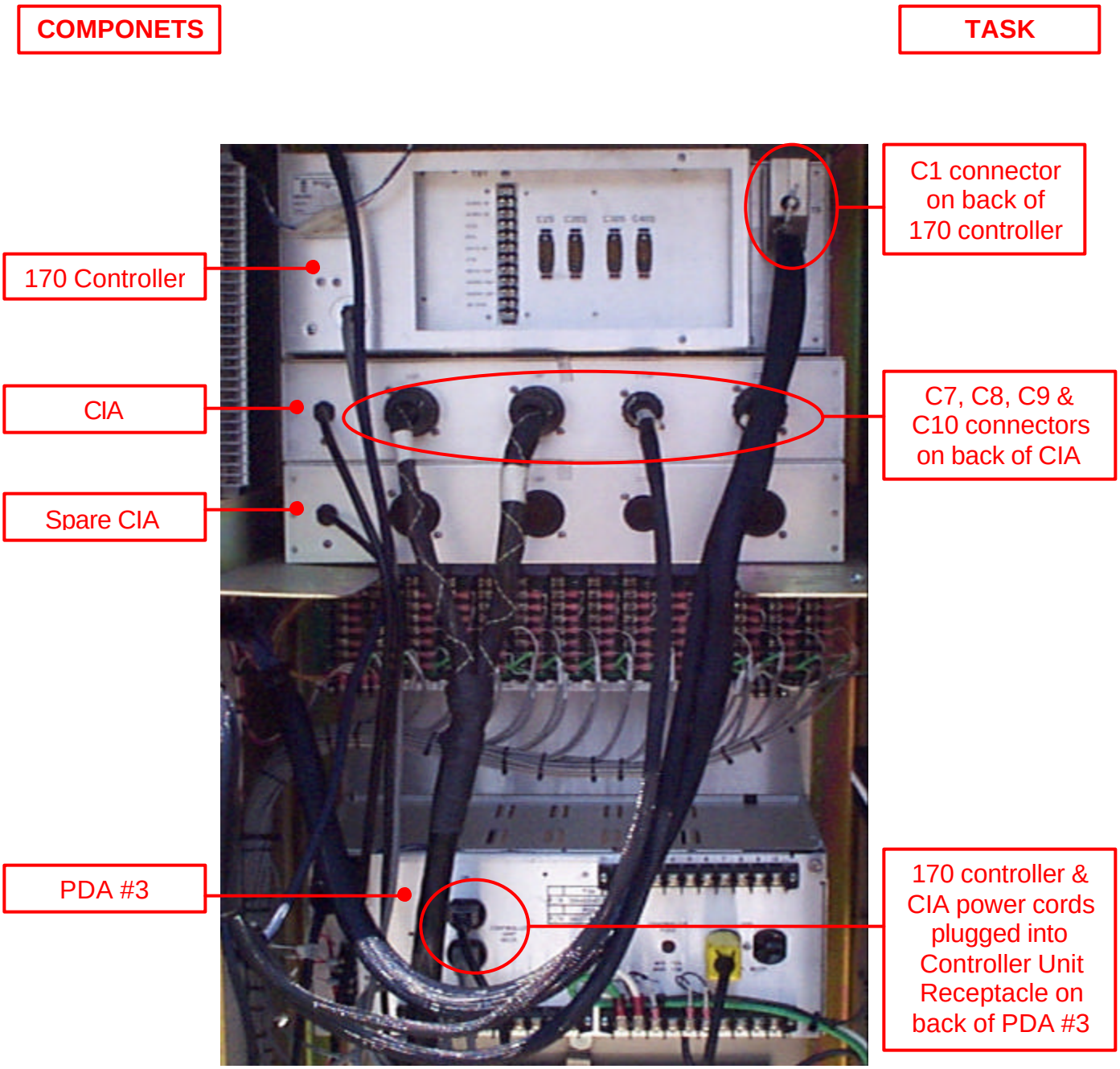


Fig. 69: Rear View Inside 334C Cabinet.

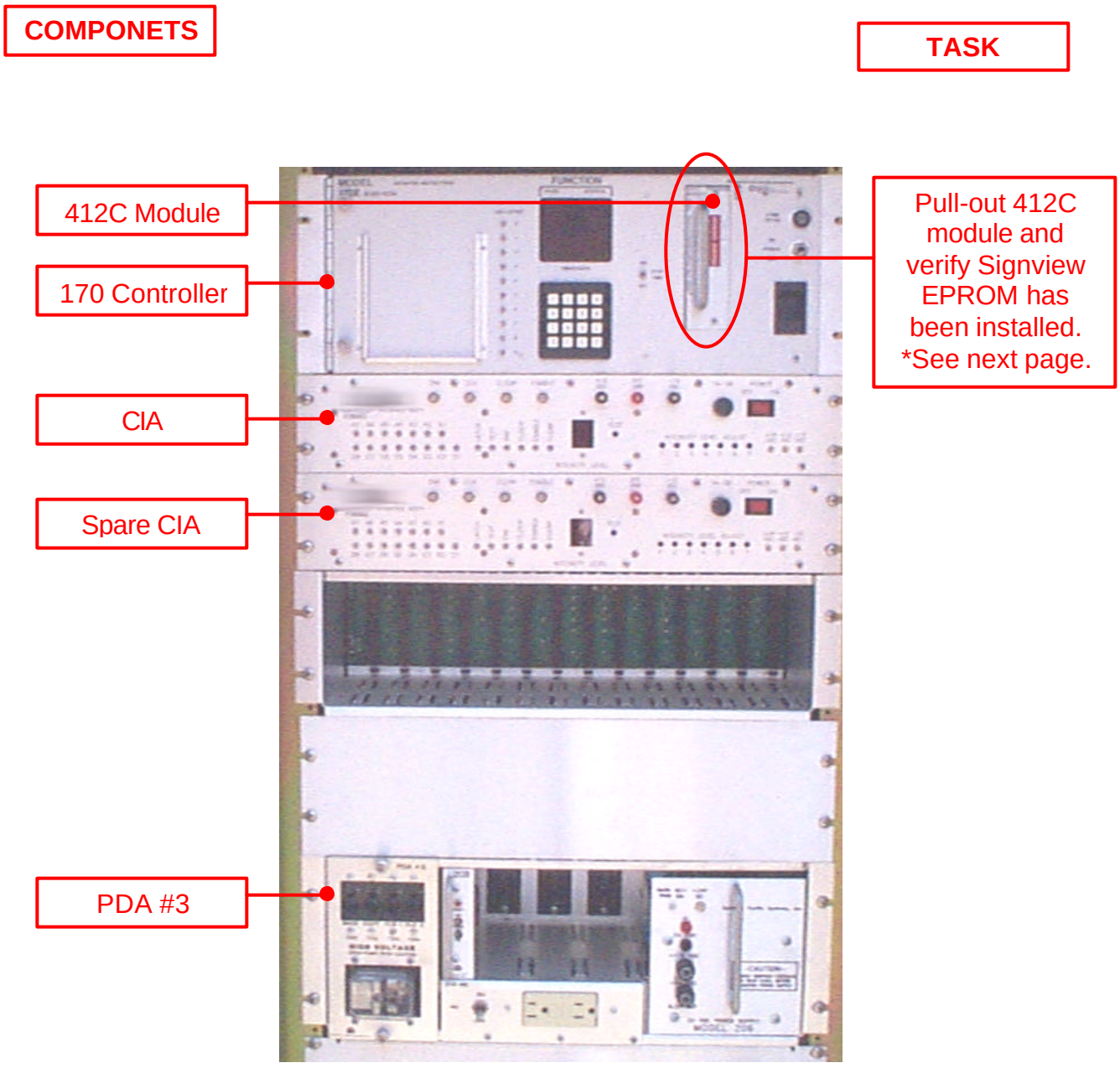


Fig. 70: Front View Inside 334C Cabinet

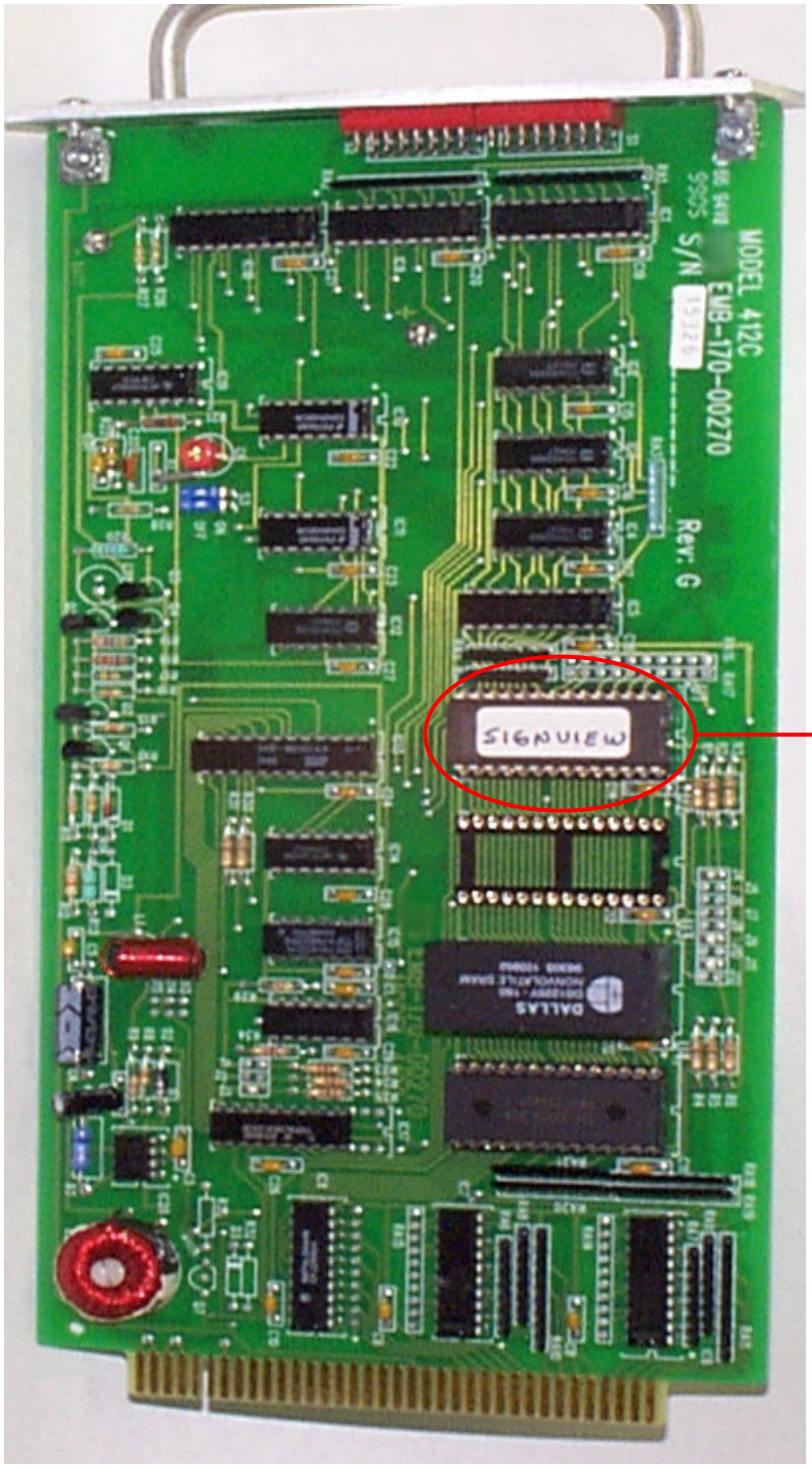


Fig. 71: Close-Up of 412C Module.

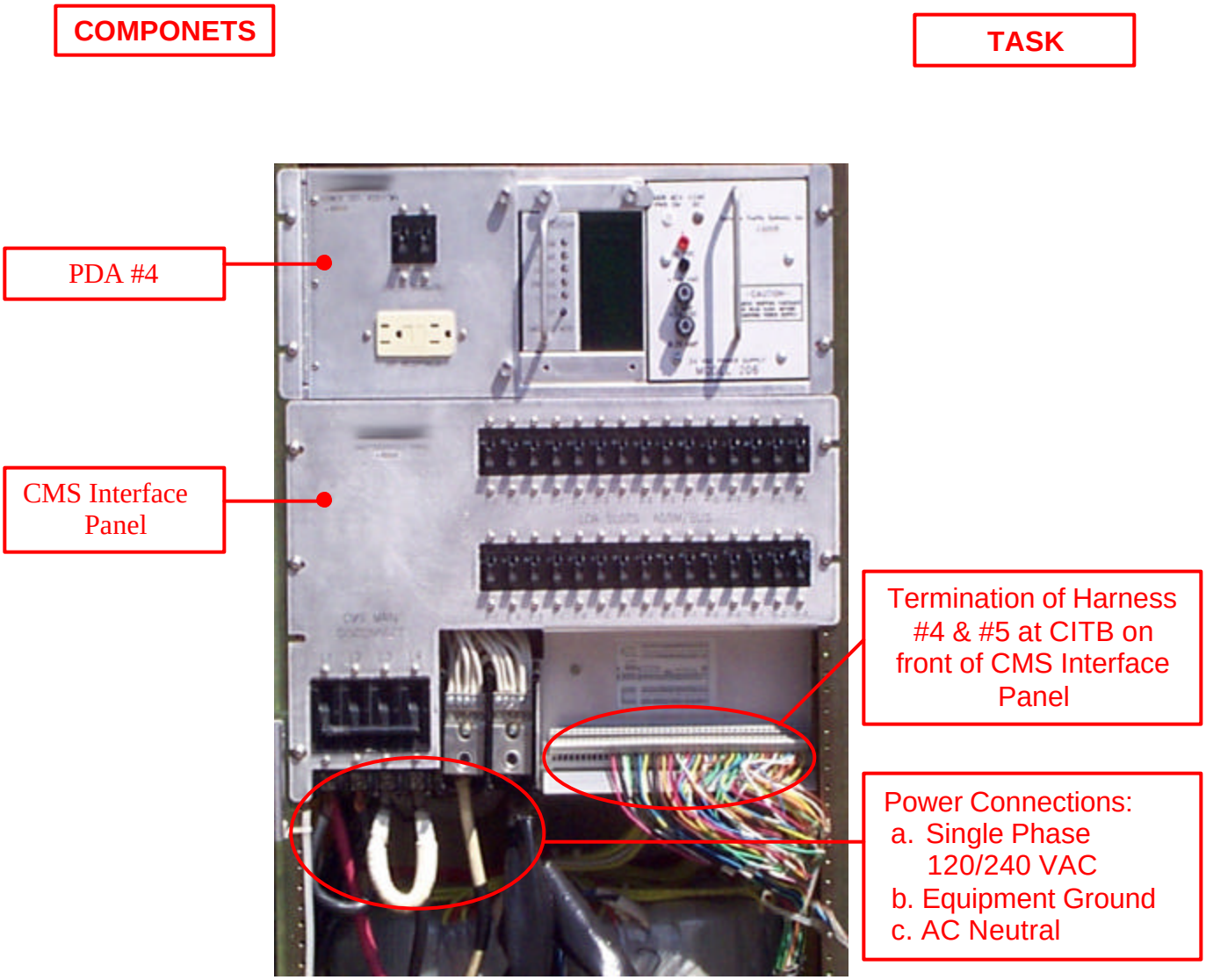


Fig. 72: Front View Inside Model 510 CMS Control Compartment.

OPERATING CMS

The following procedures outline how to manually operate the CMS system from the 170E controller.

1) In the following order, turn ON:

   a. Main breaker of power source
   b. CMS main disconnect on CIP
   c. Main breakers on PDA #4
   d. First 3 PXDA slot breakers on CIP
   e. Main, Equipment, Field 1, and Field 2 breakers on PDA #3
   f. ON/OFF switch to CIA
   g. ON/OFF switch to 170E controller
   h. Remaining PXDA slot breakers on CIP, in groups of three

2) On the 170E controller keypad, initialize the controller memory by keying in the code 3 - E - 0 - 0 - E. The base display will show "FC00". After keying in a code, always bring controller back to base display by pressing "EE" before entering the next code.

3) Key in code 0 - C - 0 - # - E, where # = 1 through 5. This will run the row bulb test with horizontal lines scrolling from top to bottom down the face of the PMM's, as shown below:

Fig. 73: Row Bulb Test.

4) Key in code 0 - C - 1 - # - E, where # = 1 through 9. This will run the column bulb test with vertical lines scrolling from left to right across the face of the PMM's, as shown on the following page.

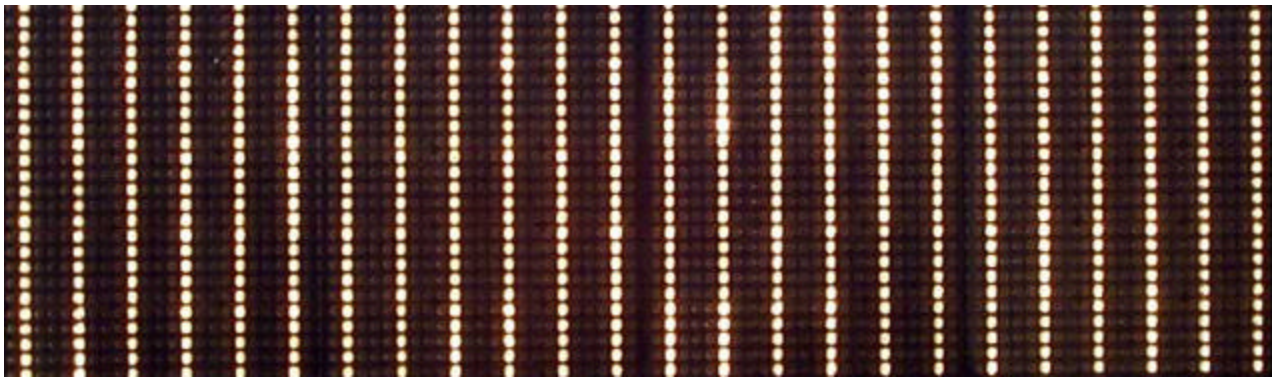


Fig. 74: Column Bulb Test.

5) Key in code 0 - C - 1 - 0 - E. This will return the display back to row bulb test.

6) Key in code 0 - C - 0 - 6 - E. This will display an alternating checkerboard field message. Display alternates between frames every two seconds. Display is shown on the following page.

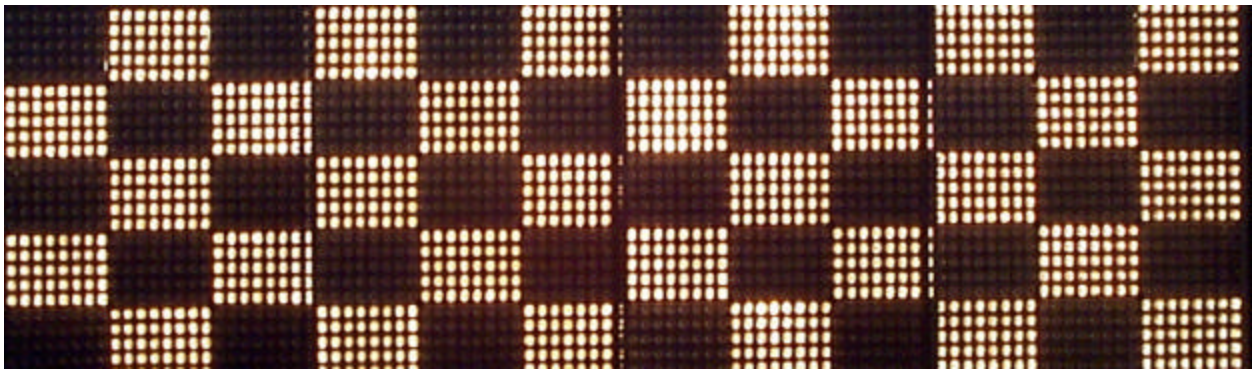


Fig. 75: Checkerboard Field Message.

7) Key in code 0 - C - 2 - # - E, where # = any value between 0.1 and 10.0 seconds. This changes the time it takes the bulbs to move from one row or column to the next. Pick a few arbitrary values to ensure the timing changes between sets and time the display to verify correct timing.

8) Key in code 0 - C - 3 - # - E, where # = 1 through 7. This sets the dim level manually. Values range from 1 (dimmest setting) to 7 (brightest setting). The controller will use the entered value and ignore the sense level received from the photo-electric sensor at all times. Key in values 1 through 7 and verify light output changes on PMM's. Also verify CIA display changes with each setting.

9) Key in code 0 - C - 3 - # - E, where # = 8 through 254. This sets the dim level automatically. The controller will use the sense level received from the photo-electric sensor at all times. Cover the photo-electric sensor and verify the light output on PMM's dim, and the CIA display changes with the sense level.

10) Key in code 0 - C - 0 - 0 - E. This will blank the CMS.

OPERATING VOLTAGE AND CURRENT

The following procedures outline how to check operating voltage and current at key test points through out the CMS system.

1) On the 170E controller keypad, key in code 0 - C - 0 - 6 - E.This will display the alternating checkerboard field message. Leave the display up and running when verifying the proper voltage and current values.

2) Verify proper voltage at +12 VDC and –12 VDC test points on CIA inside 334C cabinet. The specified tolerance is ± 2 VDC. If values are out of range, verify correct voltage is being supplied to the CIA from the 206 power supply on PDA #3. If either component is faulty, have manufacture install replacement and re-test.

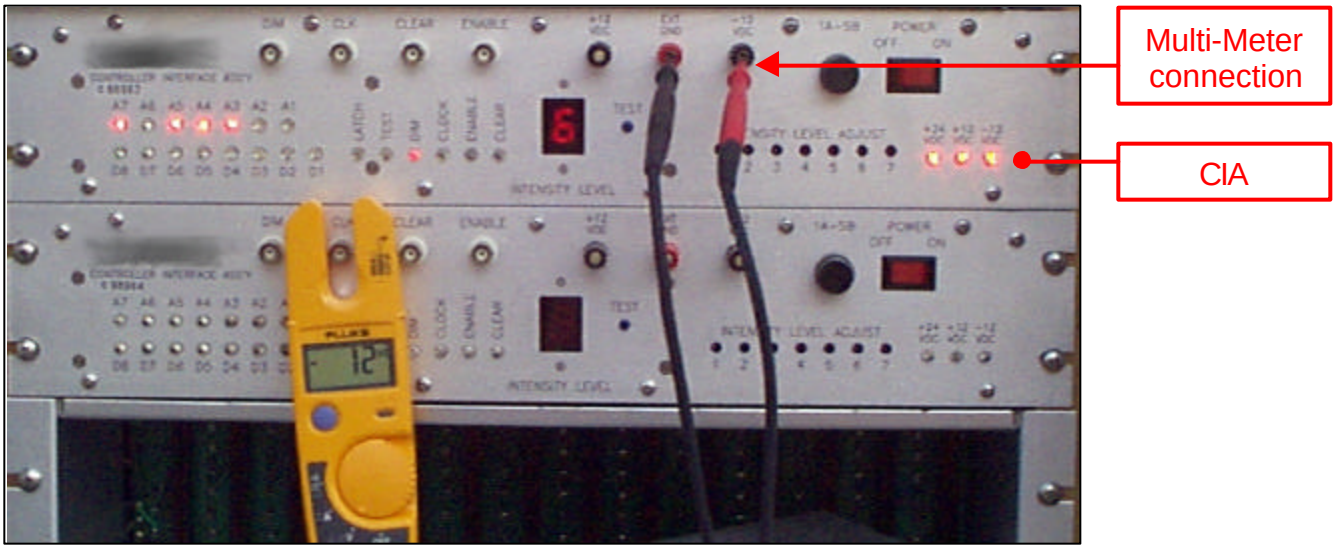


Fig. 76: -12 VDC Test Point.

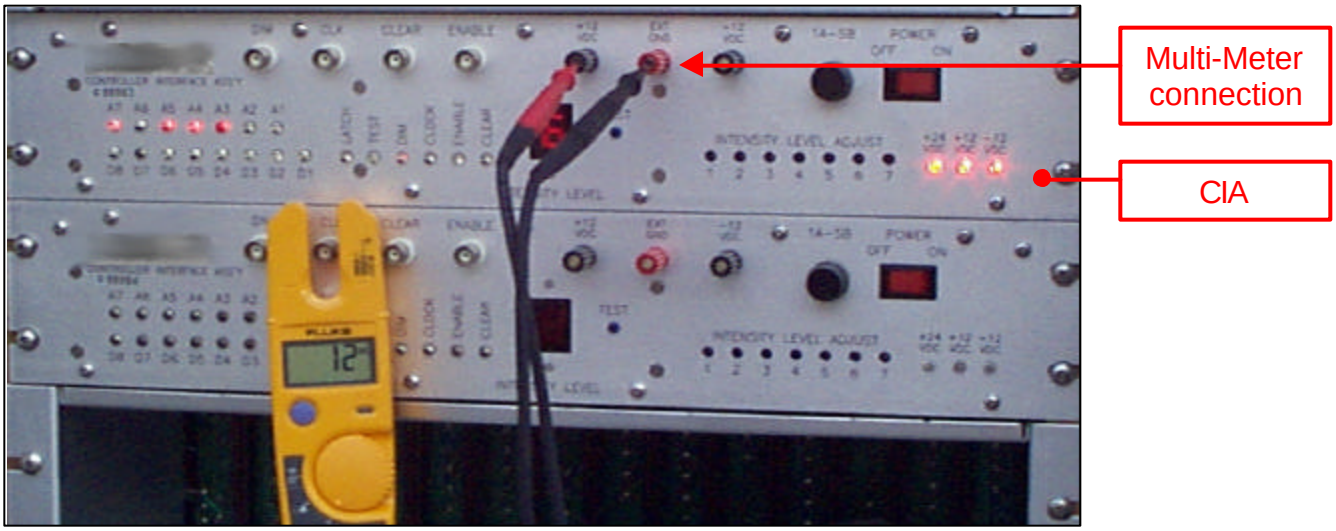


Fig. 77: +12 VDC Test Point.

3) Verify proper voltage on PDA #3 206 power supply. Measured value should meet the power supply range for +24 VDC (23.0 to 26.0 VDC). If value is out of range, have manufacture install replacement and re-test.

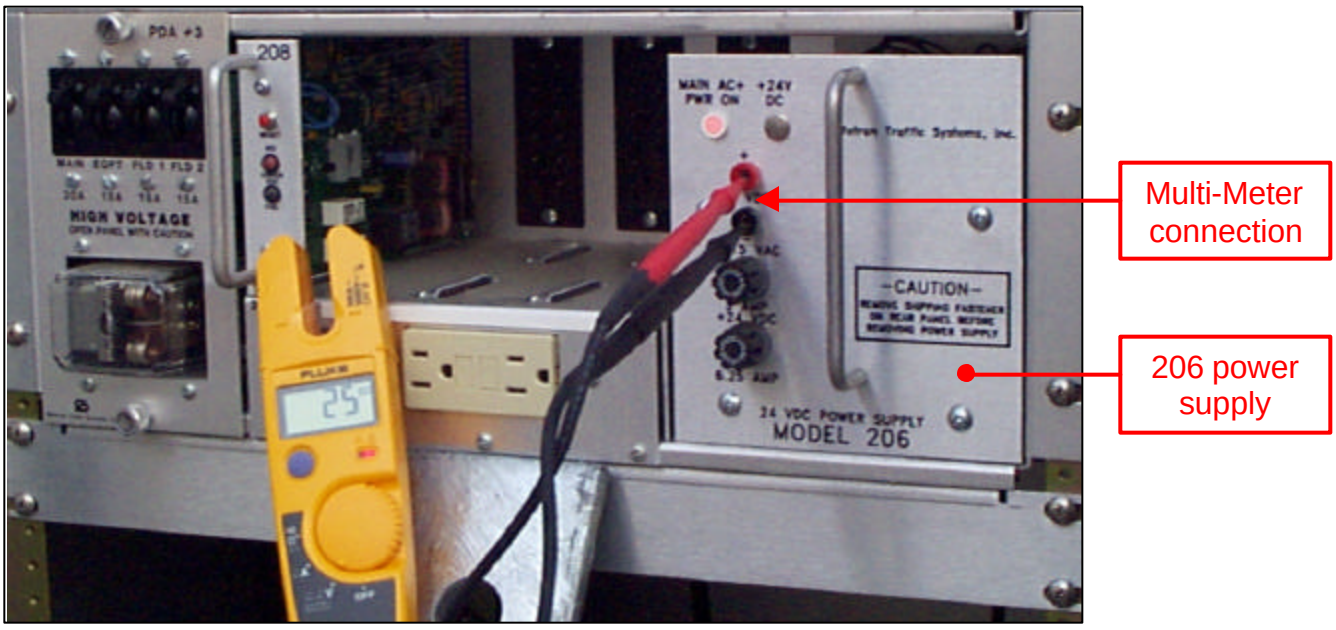


Fig. 78: PDA #3 206 Power Supply Test Point.

4) Verify proper voltage on PDA #4 206 power supply. Measured value should meet the power supply range for +24 VDC (23.0 to 26.0 VDC). If value is out of range, have manufacture install replacement and re-test.

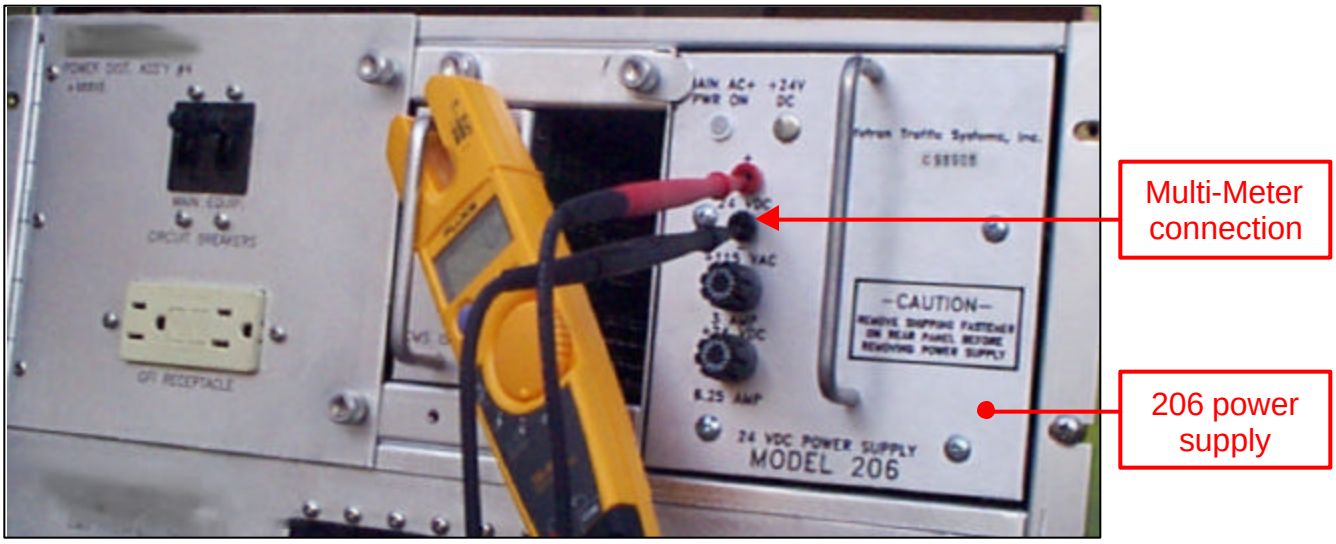


Fig. 79: PDA #4 206 Power Supply Test Point.

5) Measure current draw from each leg of CMS Main Disconnect (L1, L2, L3, L4). Values should be within the range of 22 to 26 amps. If measured values are out of range, test for current leakage between –AC neutral and equipment ground. Have manufacture troubleshoot and repair, then re-test.

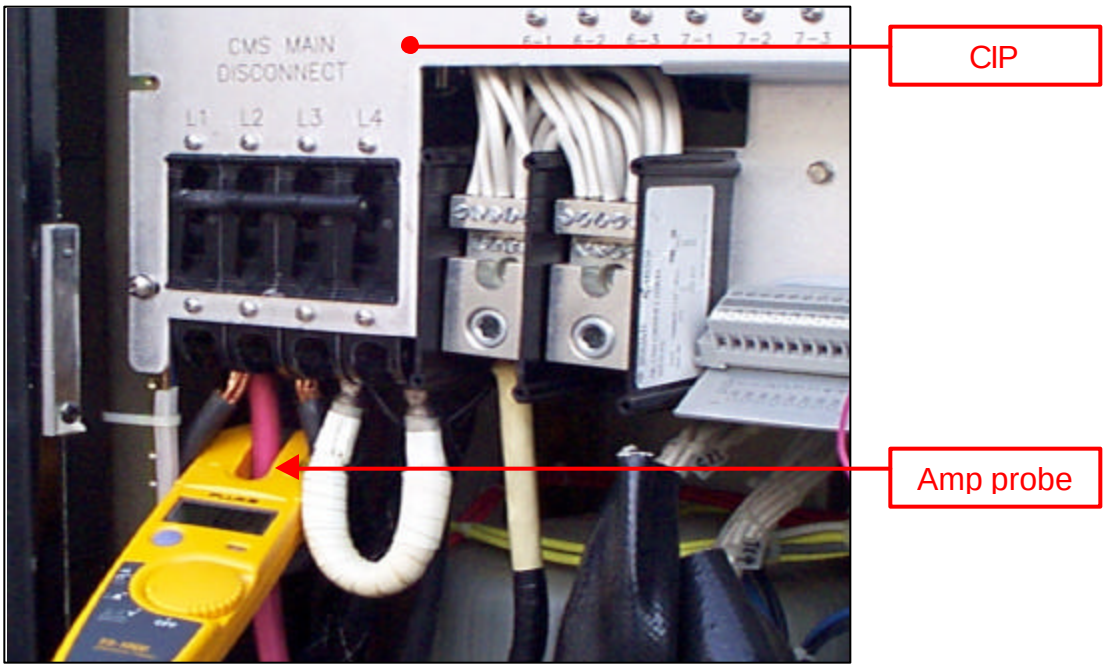


Fig. 80: Measuring Current Draw at CMS Main Disconnect.

RUNNING SIGNVIEW

The following steps outline how to run Signview from a laptop computer. In order to accept the CMS system as compliant, Signview should run without error. If errors occur while displaying messages, have manufacture troubleshoot the system then re-test.

Before turning on the Laptop, make sure it is connected to the 170 controller C2S connector using the direct mode DB9 communications cable.
(TEES July 1996 – page 8-7-29)

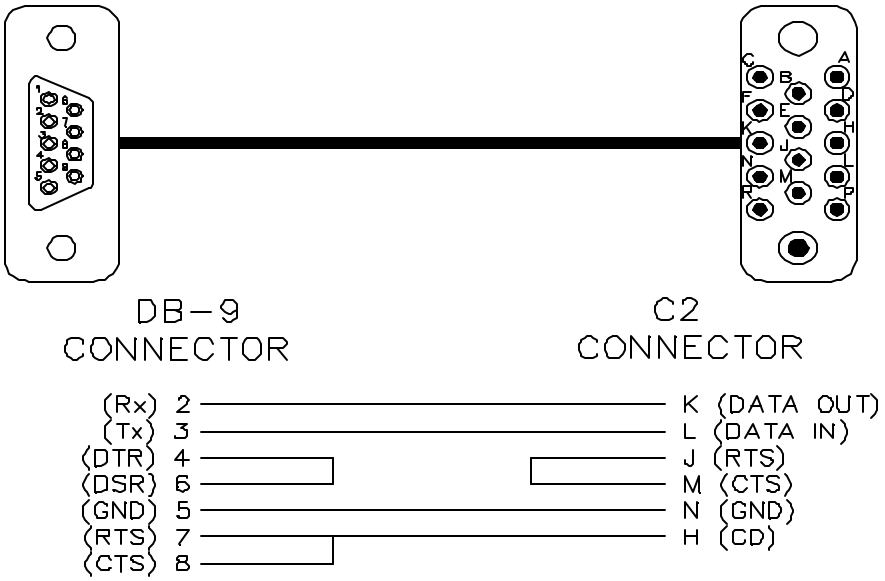


Fig. 81: DB9 Communications Cable Between Laptop and 170 Controller.

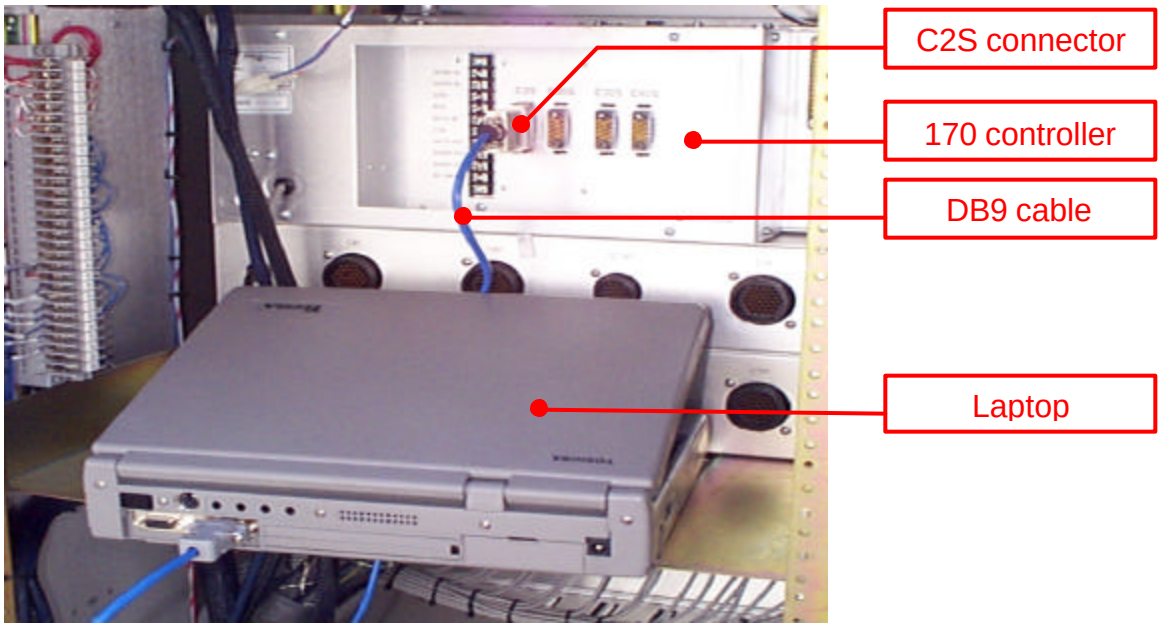
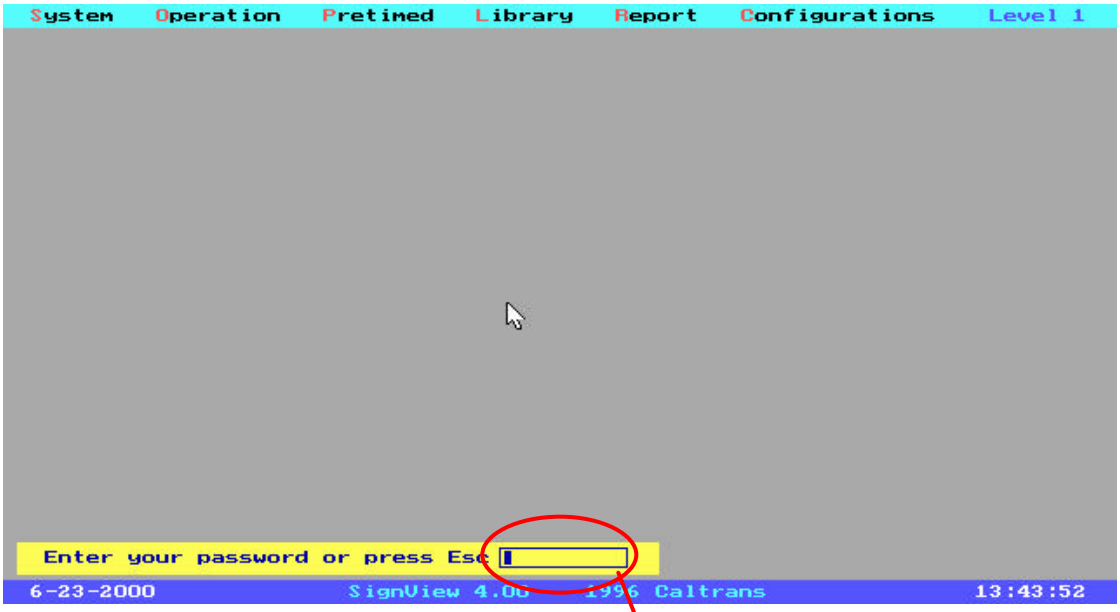
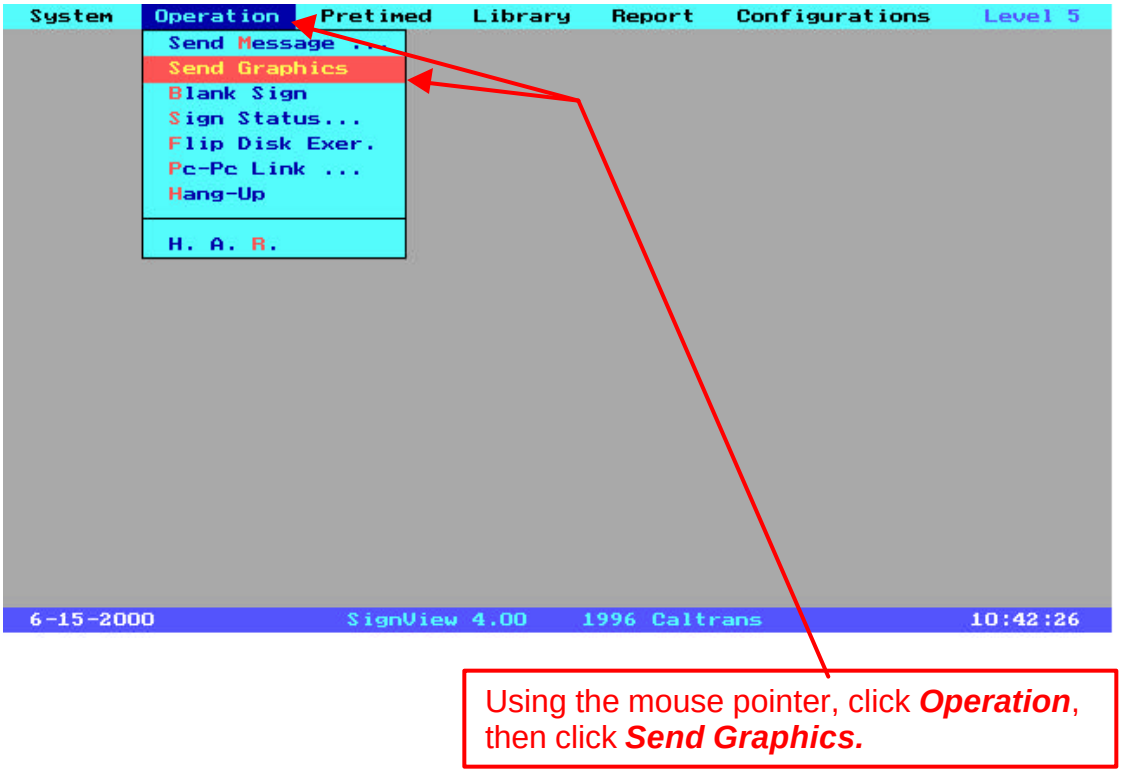
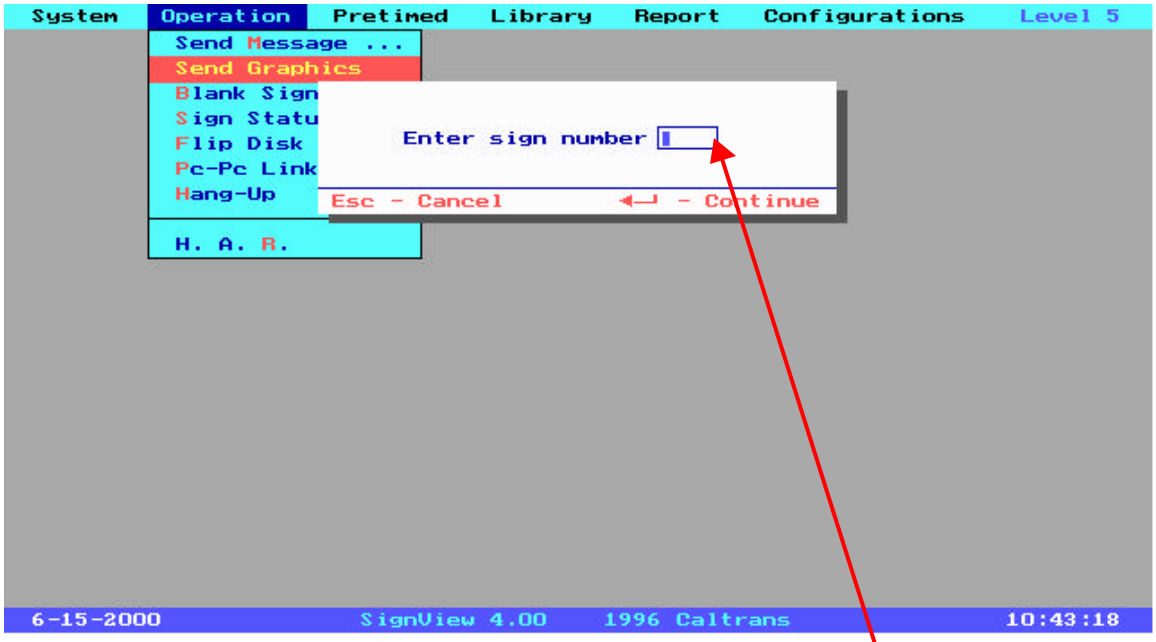


Fig. 82: Laptop Connected to 170 Controller.

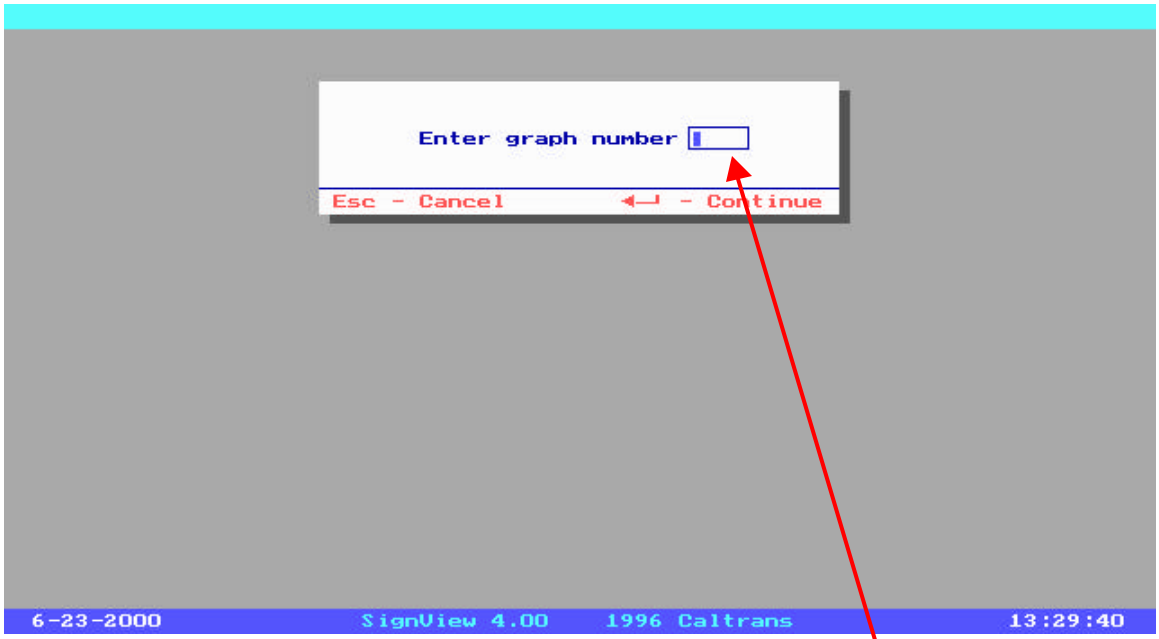
Turn on laptop and double click the Signview icon. The title page will show up briefly and then the screen will ask for a password as shown below. Enter the password then complete the following steps:



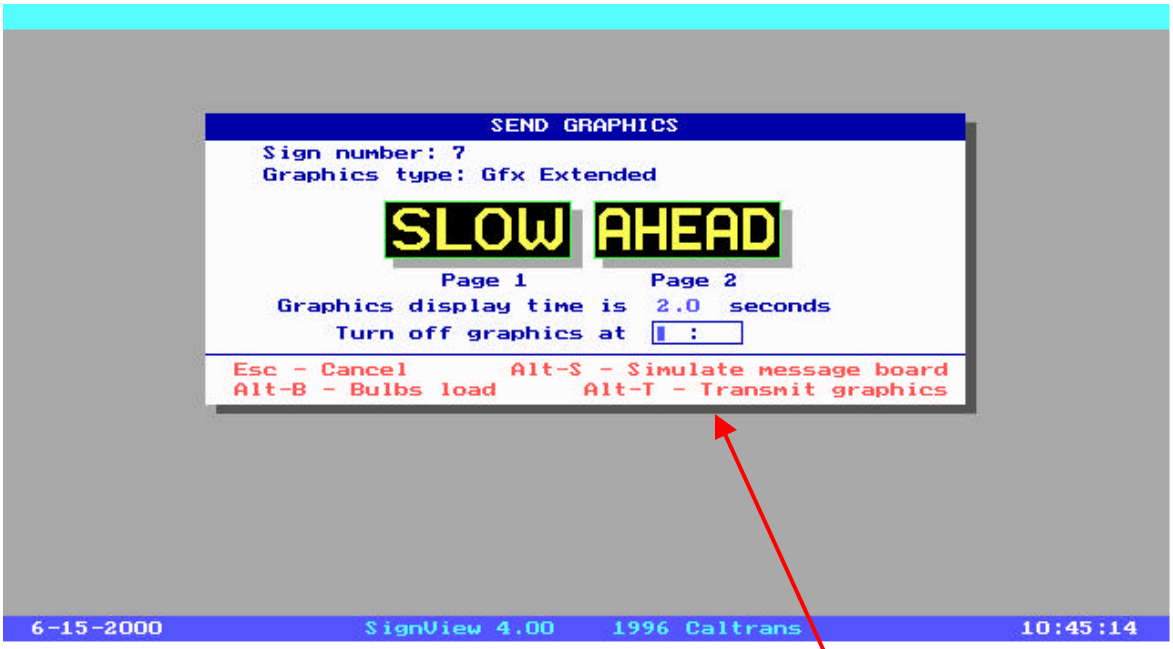




Type in a sign number then hit enter.
4 = Model 520
6 = Model 510
7 = Model 500



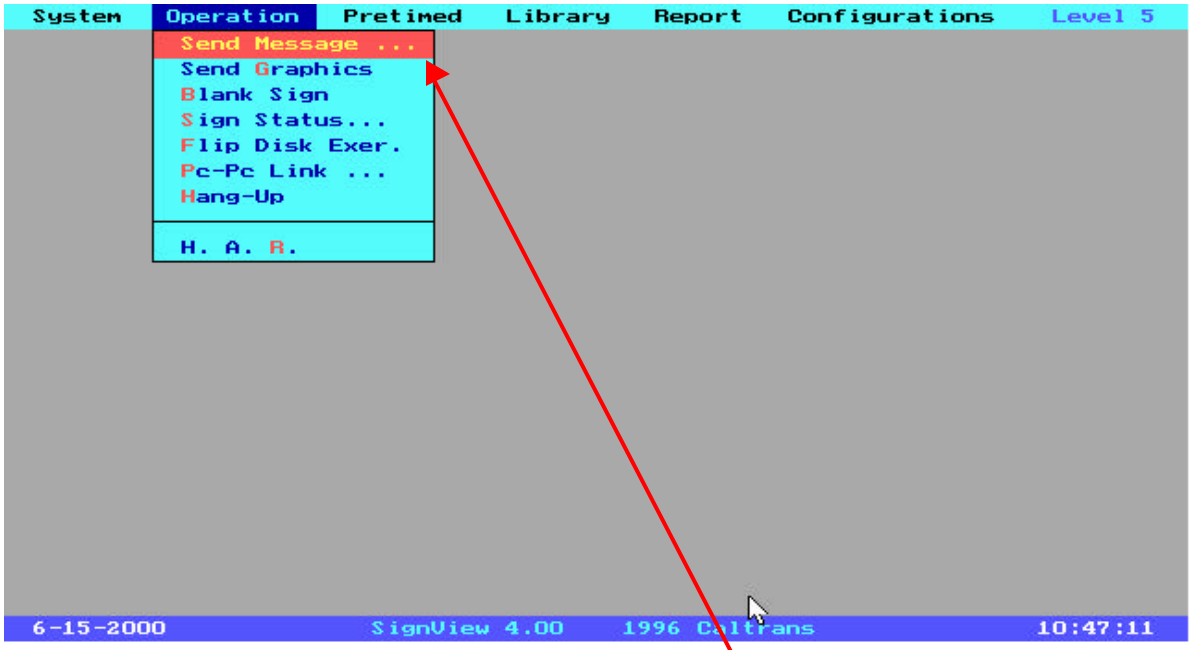
Type in a graph number then hit enter. Type in any number 1 through 11 to view the various graphs. The following example illustrates graph 3.



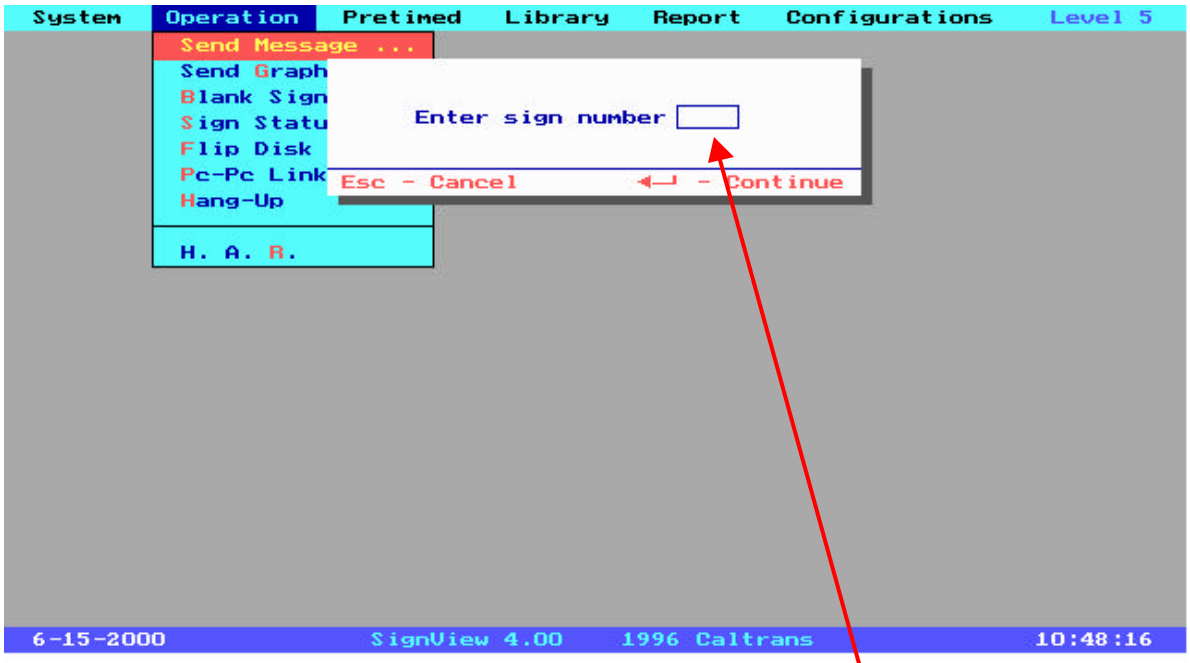
The Send Graphics window displays the graphic and ask for a turn off time. It is not necessary to enter a turn off time to send the graphic. Simply press Alt – T on the keyboard to send the graphic to the CMS.

Signview will give the prompt “GRAPHICS ACKNOWLEDGED, SIGN IS TURNED ON“. Verify the graphic is displayed correctly on the CMS. At this point, to display other graphics hit Esc and repeat the previous steps.

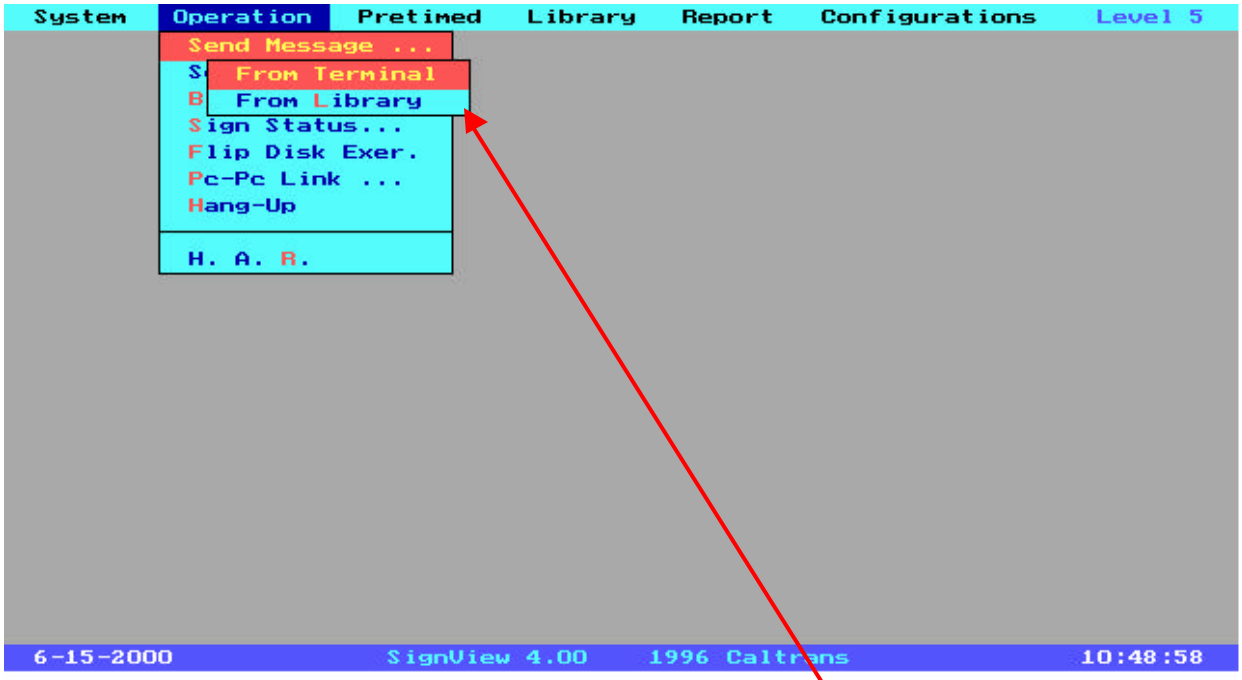
The next steps illustrate how to display typed in messages from the laptop. When a message is sent manually by an operator, it is not necessary to blank a sign first before uploading a message. Simply hit Esc until the operation menu appears.



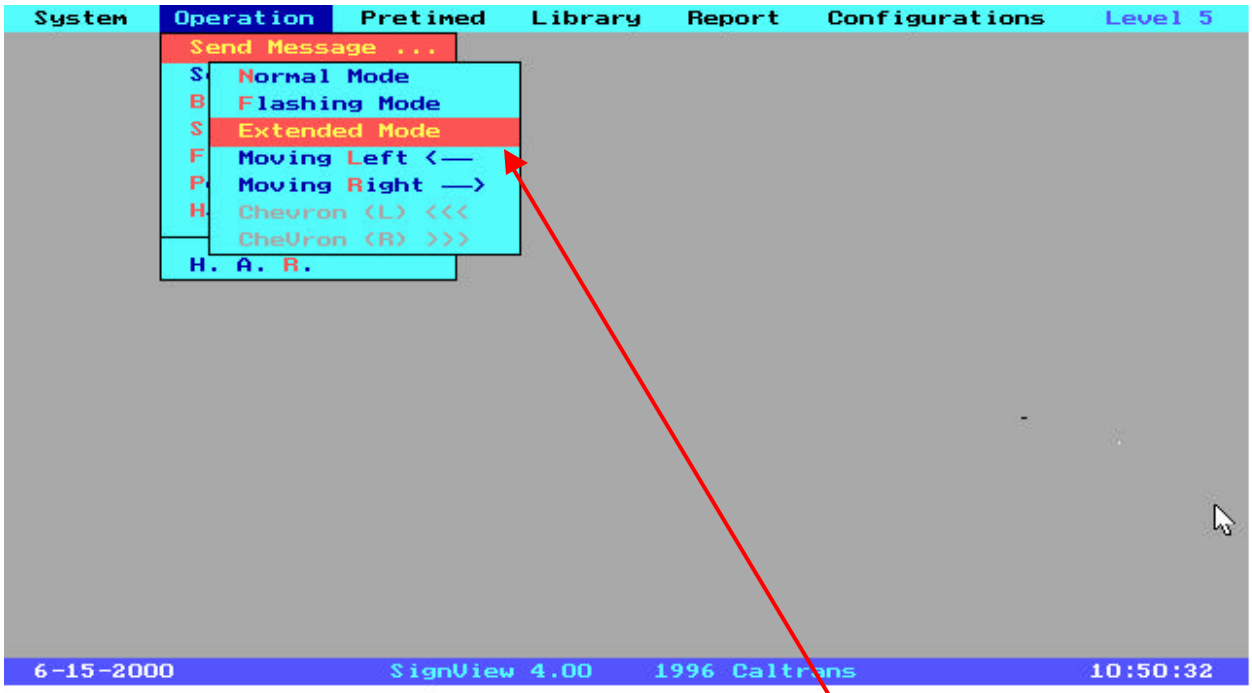
Using the mouse pointer, click ***Operation***, then click ***Send Message.***



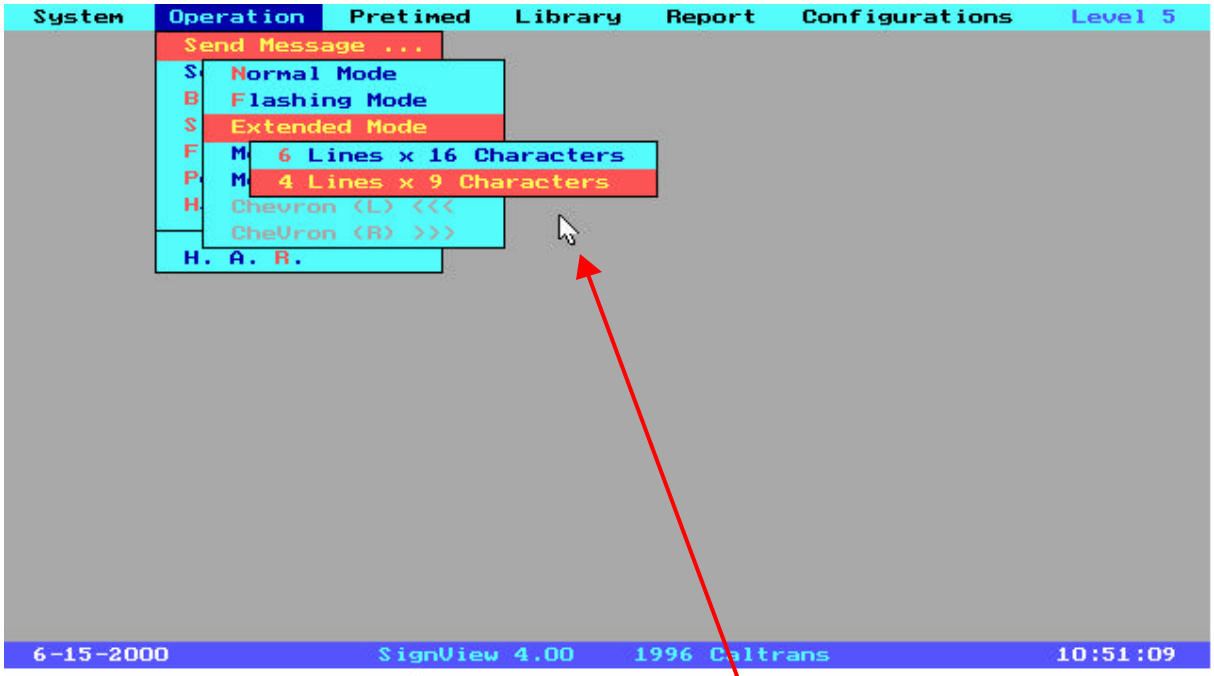
Type in a sign number then hit enter.
4 = Model 520
6 = Model 510
7 = Model 500



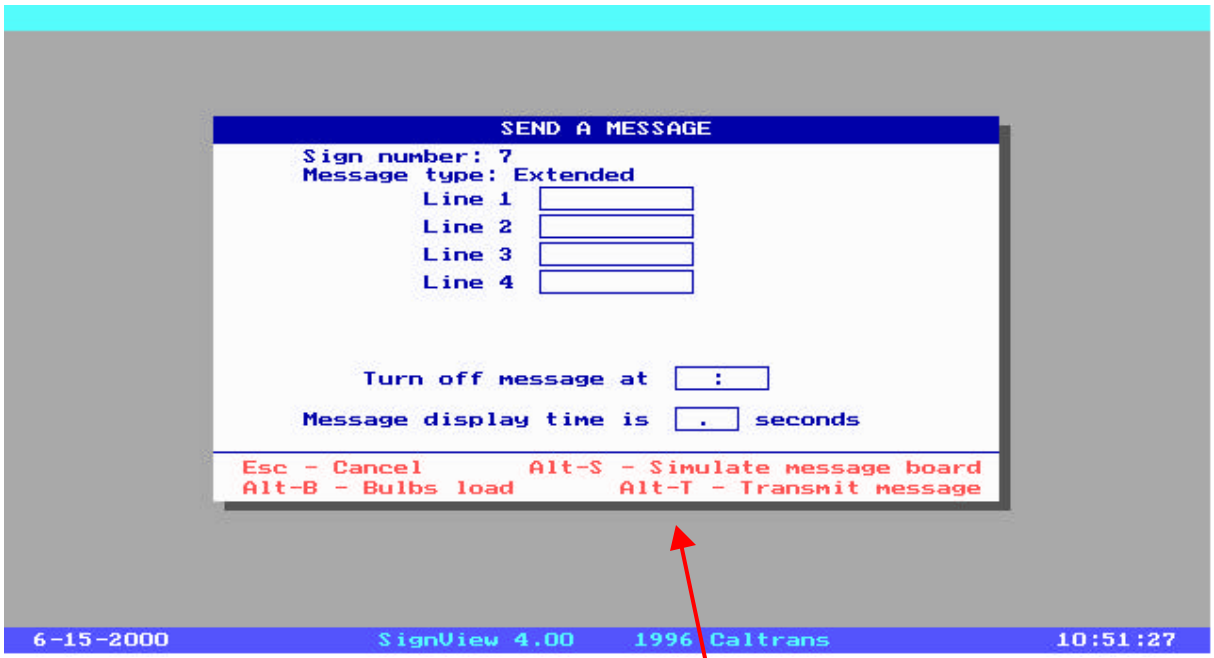
Using the mouse pointer, click ***From Terminal***.



From the sub-menu, select the type of message to send. The following example illustrates ***Extended Mode***.

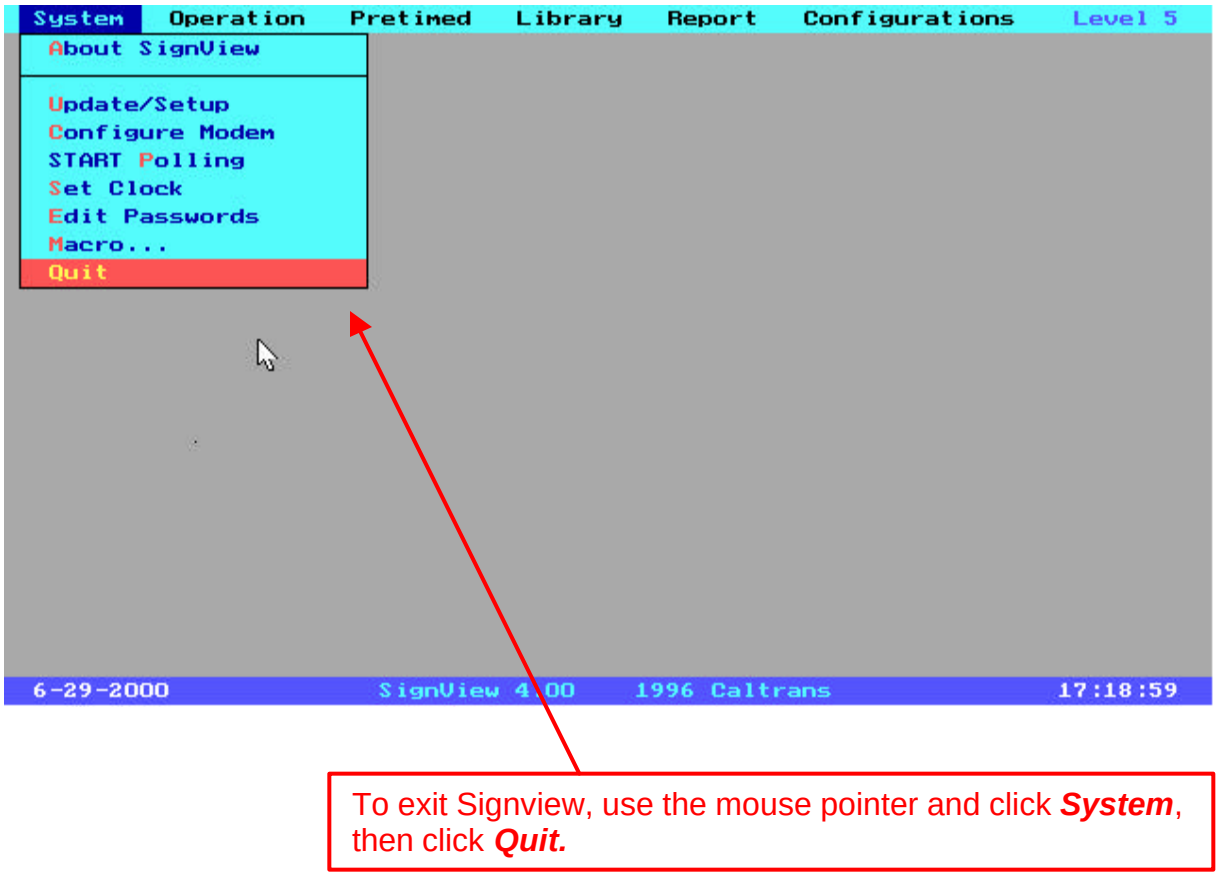


Extended Mode has two different size messages to choose from. Using the mouse pointer, click on either size.



The Send Message window appears with the necessary boxes to enter information. Type in text starting at line 1, hit Tab to proceed to the next line. It is not necessary to enter a turn off time, however a message display time between 2.0 and 4.0 seconds must be entered. Then hit Alt – T on the keyboard to send the message.

Signview will give the prompt “MESSAGE ACKNOWLEDGED, SIGN IS TURNED ON“. Verify the message is displayed correctly on the CMS. At this point, to display other messages hit Esc and repeat the previous steps.



APPENDIX

EXAMINER. _____ DATE. _____

QUALITY ASSURANCE CHECKLIST SERIAL # _____

PHYSICAL INSPECTION

STRUCTURE AND HOUSING

1) Inspection of housing
   a. Models 500 & 510 display areas 5 X 12 PMM's..... [ ] Pass [ ] Fail
   b. Model 520 display area 5 X 6 PMM's..... [ ] Pass [ ] Fail
   c. Models 510 & 520 5" border
      Model 500 6" border..... [ ] Pass [ ] Fail
   d. Interior cage support, frames, and cable trays..... [ ] Pass [ ] Fail
   e. Lifting eyebolts and labels..... [ ] Pass [ ] Fail
2) Housing dimensions
   a. Front View ..... [ ] Pass [ ] Fail
   b. Side View ..... [ ] Pass [ ] Fail
   c. Rear View (Aluminum "Z" Bar) ..... [ ] Pass [ ] Fail
   d. Top View (Eye Bolts) ..... [ ] Pass [ ] Fail
   e. Control Compartment ..... [ ] Pass [ ] Fail
   f. Matrix Display Area ..... [ ] Pass [ ] Fail
   g. Doors ..... [ ] Pass [ ] Fail
3) Inspection of welds. ..... [ ] Pass [ ] Fail
4) Inspection of Z-bar on rear ..... [ ] Pass [ ] Fail
5) Inspection of doors. ..... [ ] Pass [ ] Fail
6) Weight of CMS..... [ ] Pass [ ] Fail
7) Spare parts ..... [ ] Pass [ ] Fail

SCREEN ASSEMBLY

1) Inspection of screen assembly. ..... [ ] Pass [ ] Fail
2) Number of screen panels. ..... [ ] Pass [ ] Fail
3) Latches to lock screens. ..... [ ] Pass [ ] Fail
4) Dual tracks properly mounted. ..... [ ] Pass [ ] Fail
5) Left side end cap. ..... [ ] Pass [ ] Fail

HARNESS # 1

1) Harness components
   a. No. 22 AWG or larger conductors ..... [ ] Pass [ ] Fail
   b. 1 CAS Connector ..... [ ] Pass [ ] Fail
   c. 1 CBS Connector ..... [ ] Pass [ ] Fail
   d. 1 CCS Connector ..... [ ] Pass [ ] Fail
2) Verify that CA, CB, and CC connectors are the correct type ..... [ ] Pass [ ] Fail
3) Verify enough that enough slack is present ..... [ ] Pass [ ] Fail
4) Labeling of harness and connectors. ..... [ ] Pass [ ] Fail
5) Connectors properly keyed. ..... [ ] Pass [ ] Fail

HARNESS # 2

1) Harness components
   a. No. 22 AWG or larger conductors ..... [ ] Pass [ ] Fail
   b. 1 CD Connector ..... [ ] Pass [ ] Fail
   c. 1 CE Connector ..... [ ] Pass [ ] Fail
2) Verify that CD and CE connectors are the correct type ..... [ ] Pass [ ] Fail
3) Labeling of harness and connectors. ..... [ ] Pass [ ] Fail
4) Connectors have proper pin-out assignments ..... [ ] Pass [ ] Fail

HARNESS # 3

1) Harness components
   a. No. 22 AWG or larger conductors ..... [ ] Pass [ ] Fail
   b. 1 CF Connector ..... [ ] Pass [ ] Fail
   c. Conductors stripped and tinned ..... [ ] Pass [ ] Fail
2) Verify that CF connector is the correct type ..... [ ] Pass [ ] Fail
3) Labeling of harness and connectors. ..... [ ] Pass [ ] Fail
4) Connectors have proper pin-out assignments ..... [ ] Pass [ ] Fail

HARNESS # 4

1) Harness components
   a. 300 feet of Atlas Cable, Type A-881 or equal, 24 pr. #18 AWG multicolored..... [ ] Pass [ ] Fail
   b. Logic Signal & DC Logic Ground conductors stripped and tinned ..... [ ] Pass [ ] Fail
   c. 1 C8 Connector ..... [ ] Pass [ ] Fail
   d. 1 C9 Connector ..... [ ] Pass [ ] Fail
2) Verify that C8 and C9 connectors are the correct type ..... [ ] Pass [ ] Fail
3) Labeling of harness and connectors. ..... [ ] Pass [ ] Fail
4) Connectors properly keyed. ..... [ ] Pass [ ] Fail
5) Verify Harness #4 is neatly rolled up on a wooden reel..... [ ] Pass [ ] Fail

HARNESS # 5

1) Verify harness consist of
   a. 300 feet of Atlas Cable, Type A-881 or equal, 6 pr. #18 AWG multicolored ..... [ ] Pass [ ] Fail
   b. Conductors stripped and tinned ..... [ ] Pass [ ] Fail
2) Labeling of harness and connectors. ..... [ ] Pass [ ] Fail
3) Verify Harness #5 is neatly rolled up on a wooden reel..... [ ] Pass [ ] Fail

CHANGEABLE MESSAGE SIGN INTERFACE PANEL (CIP)

1) Labeling of front panel and components..... [ ] Pass [ ] Fail
2) CMS disconnect-4 pole, 100 Amp, 1/0 AWG lugs. ..... [ ] Pass [ ] Fail
3) AC Neutral buss. ..... [ ] Pass [ ] Fail
4) Equipment ground. ..... [ ] Pass [ ] Fail
5) 44 position terminal block-Phoenix Contact, Type MBK2.5/E or equal. ..... [ ] Pass [ ] Fail
6) Thirty (30) 1Pole-20A breakers. ..... [ ] Pass [ ] Fail
7) Verify strain relief devices are being provided for incoming harness 4 & 5..... [ ] Pass [ ] Fail

PIXEL XENON DRIVER ASSEMBLY (PXDA)

1) Dimensions of PXDA..... [ ] Pass [ ] Fail
2) Five (5) PXDA's, each with twelve 12 PDM's. ..... [ ] Pass [ ] Fail
3) Edge connectors-43/86S vertically centered, key pin inserted between slots 17 and 18. ..... [ ] Pass [ ] Fail
4) Remove 1 PXDA and verify
   a. No Jumpers on PCB Board..... [ ] Pass [ ] Fail
   b. Four 3 position terminal blocks or two six position terminal blocks ..... [ ] Pass [ ] Fail

PIXEL DRIVER MODULES (PDM)

1) Dimensions of PDM. ..... [ ] Pass [ ] Fail
2) Inspection of fabrication quality. ..... [ ] Pass [ ] Fail
3) PCB edge connectors-43/86P with key slot between pins 17 and 18. ..... [ ] Pass [ ] Fail
4) Manufactured date on electronic components not more than two (2) years old from contract award date. ..... [ ] Pass [ ] Fail
5) Interchangeability of PDM's. ..... [ ] Pass [ ] Fail
6) Three (3) - 5 ampere medium blow type fuses. ..... [ ] Pass [ ] Fail
7) Verify PDM's contain 40 pixel load triacs..... [ ] Pass [ ] Fail
8) Verify PCB components are on the left side of the board..... [ ] Pass [ ] Fail

PIXEL MATRIX MODULE (PMM)

1) PMM secured with four TDS No.2 devices. ..... [ ] Pass [ ] Fail
2) Inspection of PMM construction and materials
   a. Dimensions. ..... [ ] Pass [ ] Fail
   b. 40 xenon lamps, 5 high by 8 across. ..... [ ] Pass [ ] Fail
   c. Reflector panel . ..... [ ] Pass [ ] Fail
   d. Black paint or anodizing of reflector panel. ..... [ ] Pass [ ] Fail
   e. Surface of parabola sections. ..... [ ] Pass [ ] Fail
   f. Front cover. ..... [ ] Pass [ ] Fail
   g. Label indicating top of PMM. ..... [ ] Pass [ ] Fail
   h. Labeling of CA and CB connectors. ..... [ ] Pass [ ] Fail
3) Lamps-40 CHICAGO MINIATURE Type 1524X or THHC Type 2472X-2, or equal. ..... [ ] Pass [ ] Fail
4) Wiring-#22 AWG or larger. ..... [ ] Pass [ ] Fail
5) Lamp sockets-brass wedge base, 20 watts, 28 VAC with tabs to accommodate PMM wiring. ..... [ ] Pass [ ] Fail
6) Verify lamp sockets are rated for outdoor usage ..... [ ] Pass [ ] Fail
7) Interchangeability of PMM's. ..... [ ] Pass [ ] Fail

POWER DISTRIBUTION ASSEMBLY #4 (PDA #4)

1) Labeling of front panel and components. ..... [ ] Pass [ ] Fail
2) PDA #4 components installed .
   a. 1- Duplex NEMA 5-15R GFI ..... [ ] Pass [ ] Fail
   b. 1- 1 Pole 15 Amp, 120VAC Equipment circuit breaker ..... [ ] Pass [ ] Fail
   c. 1- 1 Pole 15 Amp, 120VAC Main circuit breaker ..... [ ] Pass [ ] Fail
   d. 1- Model 206 Power Supply Module ..... [ ] Pass [ ] Fail
   e. 1- 10 Position Terminal Block T2 ..... [ ] Pass [ ] Fail
   f. 1- 4 Position Terminal Block T3 ..... [ ] Pass [ ] Fail
   g. 1- CFP Connector ..... [ ] Pass [ ] Fail
   h. 5- CEP Connector ..... [ ] Pass [ ] Fail
   i. 1- CMS Isolation Module ..... [ ] Pass [ ] Fail
3) Gas tube type surge protection device mounted externally across T2. ..... [ ] Pass [ ] Fail
4) Mechanical retainers are for Isolation Module and Model 206 power supply. . ..... [ ] Pass [ ] Fail

CMS ISOLATION MODULE (CMS ISO MOD)

1) Labeling of front panel and components.....[ ] Pass [ ] Fail
2) Inspection of fabrication quality. .....[ ] Pass [ ] Fail
3) Manufactured date on electronic components not more than two (2) years old from contract award date. .....[ ] Pass [ ] Fail
4) Components on left side when Isolation Module is installed. .....[ ] Pass [ ] Fail
5) Test switch and five indicators are installed on the front panel. .....[ ] Pass [ ] Fail

TRANSFORMERS

1) Verify proper transformers and rating.....[ ] Pass [ ] Fail
2) Verify manufacturers name and part number label.....[ ] Pass [ ] Fail
3) Transformer leads color coded or labeled.....[ ] Pass [ ] Fail
4) Connected between CMS main disconnect and PXDA breakers..... [ ] Pass [ ] Fail

VENTILATION SYSTEM

1) Inspect louvered vents.....[ ] Pass [ ] Fail
2) All electric fan(s)/devices are contained in control compartment only. .....[ ] Pass [ ] Fail
3) Removable filter held by spring loaded top clamp.....[ ] Pass [ ] Fail
4) Filter material. .....[ ] Pass [ ] Fail
5) Proper operation of thermostatically controlled fan assembly. .....[ ] Pass [ ] Fail

334C CABINET 334C CABINET s/n _____

1) Inspect cabinet, doors, locks, hinges, police panels, ventilation, gasketing etc. ..... [ ] Pass [ ] Fail
2) Housing dimensions[ ] Pass [ ] Fail
3) Verify operation of cabinet doors .....[ ] Pass [ ] Fail
4) Two (2) copies of manual. ... .[ ] Pass [ ] Fail
5) Cabinet components installed.
   a. Thermostatically controlled fan assembly ..... [ ] Pass [ ] Fail
   b. Photo Cell Assembly ..... [ ] Pass [ ] Fail
   c. Terminal Block TB1 ..... [ ] Pass [ ] Fail
   d. Terminal Block TB2 ..... [ ] Pass [ ] Fail
   e. Two (2) CIA's .....[ ] Pass [ ] Fail
   f. Input File.....[ ] Pass [ ] Fail
   g. PDA #3 .....[ ] Pass [ ] Fail
6) Labeling of terminal blocks. .....[ ] Pass [ ] Fail

PHOTO-ELECTRIC SENSOR ASSEMBLY

1) Type and size of photo sensor. ..... [ ] Pass [ ] Fail
2) Cell has one (1.00) square inch glass windows. .....[ ] Pass [ ] Fail
3) Connection of photo sensor. ..... [ ] Pass [ ] Fail

CONTROLLER ISOLATION ASSEMBLY (CIA)

1) Verify Proper dimensions and labeling.....[ ] Pass [ ] Fail
2) Verify that a one (1) amp fuse is provided ..... [ ] Pass [ ] Fail
3) Verify required BNC connectors and test points are provided.. .....[ ] Pass [ ] Fail

POWER DISTRUBUTION ASSEMPLY #3 (PDA #3)

1) Verify all labeling is correct. .....[ ] Pass [ ] Fail
2) PDA #3 components installed
   a. 1 - 1 pole 30 Amperes, 120 VAC Main circuit breaker ..... [ ] Pass [ ] Fail
   b. 3 - 1 pole 15 Amperes, 120 VAC circuit breaker (Equip., Field 1 & Field 2) ..... [ ] Pass [ ] Fail
   c. 1 - Model 208 Monitor Unit ..... [ ] Pass [ ] Fail
   d. 1 - Model 206 Power Supply ..... [ ] Pass [ ] Fail
   e. 1 - Model 430 heavy duty relay ..... [ ] Pass [ ] Fail
   f. 3 - Model 200 Switch Pack sockets ..... [ ] Pass [ ] Fail
   g. 1 - Duplex NEMA 5-15R Controller receptacle ..... [ ] Pass [ ] Fail
   h. 2 - Duplex NEMA 5-15R Equipment receptacle (one with GFI) ..... [ ] Pass [ ] Fail
   i. 3 - 10 position terminal blocks (T1, T2 & T4) ..... [ ] Pass [ ] Fail
   j. 1 - 4 position terminal block (T3) ..... [ ] Pass [ ] Fail

FUNCTIONAL TESTING

OPERATING CMS

1) Turn ON:
   a. Main breaker of power source
   b. CMS main disconnect on CIP
   c. Main breakers on PDA #4
   d. First 3 PXDA slot breakers on CIP
   e. Main, Equipment, Field 1, and Field 2 breakers on PDA #3
   f. ON/OFF switch to CIA
   g. ON/OFF switch to 170E controller
   h. Remaining PXDA slot breakers on CIP, in groups of three
2) Iinitialize controller, key in 3 - E - 0 - 0 - E.
3) Row bulb test, key in 0 - C - 0 - # - E, where # = 1 through 5……[ ] Pass [ ] Fail
4) Checkerboard field message, key in code 0 - C - 0 - 6 – E……..[ ] Pass [ ] Fail
5) Key in code 0 - C - 1 - # - E, where # = 1 through 9. This will run the column bulb test with vertical lines scrolling from left to right across the face of the PMM's, as shown below
6) Key in code 0 - C - 1 - 0 - E. This will return the display back to row bulb test.
7) Timing, key in code 0 - C - 2 - # - E, where # = 0.1 and 10.0 seconds. ……[ ] Pass [ ] Fail
8) Manual dim, key in code 0 - C - 3 - # - E, where # = 1 through 7……[ ] Pass [ ] Fail
9) Auto dim, key in code 0 - C - 3 - # - E, where # = 8 through 254……[ ] Pass [ ] Fail
10) Blank CMS, key in code 0 - C - 0 - 0 – E……[ ] Pass [ ] Fail

OPERATING VOLTAGE AND CURRENT

1) Checkerboard field message, key in code 0 - C - 0 - 6 – E……[ ] Pass [ ] Fail
2) CIA test points, +12 VDC and –12 VDC …….. [ ] Pass [ ] Fail
3) PDA #3 206 power supply, +24 VDC (23.0 to 26.0 VDC)……..[ ] Pass [ ] Fail
4) PDA #4 206 power supply, +24 VDC (23.0 to 26.0 VDC)……..[ ] Pass [ ] Fail
5) Current draw at CMS Main Disconnect, 20 to 26 amps……[ ] Pass [ ] Fail

RUNNING SIGNVIEW

1) Run graphic, verify display is correct……[ ] Pass [ ] Fail
2) Run message, extended mode, verify display is correct……[ ] Pass [ ] Fail

GLOSSARY

GLOSSARY

Wherever the following terms or abbreviations are used, the intent and meaning shall be interpreted as follows:

A	**-**	**Ampere**
AC	**-**	**Alternating Current**
AC+	**-**	**120 Volts AC, 60 hertz ungrounded power source**
AC-	**-**	**120 Volts AC, 60 hertz grounded return to the power source**
AGENCY	**-**	**Purchasing Government Agency**
ANSI	**-**	**American National Standard Institute**
ASCII	**-**	**American Standard Code for Information Interchange**
Assembly	**-**	**A complete machine, structure or unit of a machine that was manufactured by fitting together parts and/or modules**
ASTM	**-**	**American Society for Testing and Materials**
AWG	**-**	**American Wire Gage**
C	**-**	**Celsius**
C Language	**-**	**The ANSI C Programming Language**
Cabinet	**-**	**An outdoor enclosure generally housing the controller unit and associated equipment**
Certificate of Compliance	**-**	**A certificate signed by the manufacturer of the material or the manufacturer of assembled materials stating that the materials involved comply in all respects with the requirements of the specifications**
Channel	**-**	**An information path from a discrete input to a discrete output**
CIA	**-**	**CMS Controller Isolation Assembly**
CIP	**-**	**CMS Interface Panel**

CMOS	**-**	**Complementary Metal Oxide Semiconductor**
CMS	**-**	**Changeable Message Sign**
CMS SYSTEM	**-**	**Includes Controller Unit, Model 334C Cabinet, Interconnect Harnesses, CMS and other associated equipment required to operate the system.**
Component	**-**	**Any electrical or electronic device**
Contractor	**-**	**The person or persons, manufacturer, firm, partnership, corporation, vendor or combination thereof, who have entered into a contract with the AGENCY, as party(s) of the second part or legal representative**
Controller Unit	**-**	**That portion of the controller assembly devoted to the operational control of the logic decisions programmed into the assembly**
CPU	**-**	**Central Processing Unit**
CR	**-**	**ACIA Control Register**
CRC	**-**	**Cyclic Redundancy Check**
DAT Program	**-**	**The AGENCYs Diagnostic and Acceptance Test Program**
dB	**-**	**Decibel**
dBa	**-**	**Decibels above reference noise, adjusted**
DC	**-**	**Direct Current**
DIN	**-**	**Deutsche Industrie Norm**
DMA	**-**	**Direct Memory Access**
DTA	**-**	**Down Time Accumulator**
EG	**-**	**Equipment Ground**
EIA	**-**	**Electronic Industries Association**
EMI	**-**	**Electro Magnetic Interference**

Engineer	**-**	**The AGENCY director, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties delegated to them**
EPROM	**-**	**Ultraviolet Erasable, Programmable, Read Only Memory Device**
EEPROM	**-**	**Electrically Erasable, Programmable, Read Only Memory Device**
Equal	**-**	**Connectors: comply to physical dimensions, contact material, plating and method of connection. Devices: conforming to function, pin out, electrical and operating parameter requirements, access times and interface parameters of the specified device**
ETL	**-**	**Electrical Testing Laboratories, Inc.**
Firmware	**-**	**A computer program or software stored permanently in PROM, EPROM, ROM or semi-permanently in EEPROM**
FLASH	**-**	**A +5 VDC powered IC Memory Device with nonvolatile, electrically erasable, programmable, 100K read/write minimum cycles and fast access time features**
FPA	**-**	**Front Panel Assembly**
HEX	**-**	**Hexadecimal**
Hz	**-**	**Hertz**
IC	**-**	**Integrated Circuit**
I.D.	**-**	**Identification**
IEEE	**-**	**Institute of Electrical and Electronics Engineers**
ISO	**-**	**International Standards Organization**
Jumper	**-**	**A means of connecting/disconnecting two or more conductive by soldering/desoldering a conductive wire or by PCB post jumper**
KB	**-**	**Kilobytes**

Laboratory	**-**	**The established laboratory of the AGENCY or other laboratories authorized by the AGENCY to test materials involved in the contract**
LED	**-**	**Light Emitting Diode**
LOGIC	**-**	**Negative Logic Convention (Ground True) State**
LSB	**-**	**Least Significant Byte**
lsb	**-**	**Least Significant Bit**
MB	**-**	**MegaByte**
MSB	**-**	**Most Significant Byte**
msb	**-**	**Most Significant Bit**
m	**-**	**Milli**
MCU/MPU/ IMP	**-**	**Micro Controller Unit, Microprocessor Unit, or Integrated Multiprotocol Processor**
MIL	**-**	**Military Specifications**
MODEM	**-**	**Modulation/Demodulation Unit**
Module	**-**	**A functional unit that plugs into an assembly**
Motherboard	**-**	**A printed circuit connector interface board with no active or passive components**
MOS	**-**	**Metal-Oxide Semiconductor**
MOV	**-**	**Metal-Oxide Varistor**
MS	**-**	**Military Standards**
M/170	**-**	**Program Module/Model 170 Controller Unit Connector**
M/170E	**-**	**Model 170E Auxiliary Board Connector**
N	**-**	**Newton: SI unit of force**
N.C.	**-**	**Normally closed contact**

N.O.	**-**	**Normally open contact**
NA	**-**	**Presently Not Assigned. Cannot be used by the contractor for other purposes**
NEMA	**-**	**National Electrical Manufacturer's Association**
NETA	**-**	**National Electrical Testing Association, Inc.**
n	**-**	**nano**
NLSB	**-**	**Next Least Significant Byte**
nlsb	**-**	**Next Least Significant Bit**
NMSB	**-**	**Next Most Significant Byte**
nmsb	**-**	**Next Most Significant Bit**
PCB	**-**	**Printed Circuit Board**
PDA	**-**	**Power Distribution Assembly**
PDM	**-**	**CMS Pixel Driver Module**
PLA/PAL	**-**	**Programmable Array Logic Device**
PMM	**-**	**CMS Pixel Matrix Module**
Power Failure	**-**	**A Power Failure is said to have occurred when the incoming line voltage falls below 92 +/- 2 VAC for 50 ms. See Power Conditions.**
Power Restoration	**-**	**Power is said to be restored when the incoming line voltage equals or exceeds 97 +/- 2 VAC for 50 ms. See Power Conditions.**
Power Conditions	**-**	**16.7 ms (one 60 Hz cycle) reaction period is allowed to be included in the 50 ms timing or added to (67 ms duration). The hysteresis between power failure and power restoration voltage settings shall be a min. of 5 VAC with a threshold drift of no more than 0.2 VAC.**
ppm	**-**	**Parts per million**
PXDA	**-**	**CMS Pixel Driver Assembly**

PWM	**-**	**Pulse Width Modulation**
RAM	**-**	**Random Access Memory**
RDR	**-**	**ACIA Receiver Data Register**
RF	**-**	**Radio Frequency**
RMS	**-**	**Root-Mean-Square**
ROM	**-**	**Read Only Memory Device**
RTC	**-**	**Model 170E Controller Unit Real Time Clock. This circuitry provides a 170E CPU IRQ Interrupt pulse clocked off of the local power company's line frequency every 16.67 ms.**
RTCA	**-**	**Real Time Clock Adjuster Circuitry**
RTS	**-**	**Request to Send**
R/W	**-**	**Model 170E Controller Unit Read/Write Control Line**
SCI	**-**	**Serial Communications Interface**
SDLC	**-**	**Synchronous Data Link Control**
S	**-**	**Logic State**
s	**-**	**second**
Second Sourced	**-**	**Produced by more than one manufacturer**
SR	**-**	**ACIA Status Register**
SRAM	**-**	**Static Random Access Memory Device**
SW	**-**	**Switch**
TB	**-**	**Terminal Block**
TDR	**-**	**ACIA Transmit Data Register**
TOD	**-**	**Time Of Day Clock**

Triac	**-**	**Silicon-Controlled Rectifier which controls power bilaterally in an AC switching circuit**
TTL	**-**	**Transistor-Transistor Logic**
Thumb Screw Device	**-**	**(TSD) A retractable screw fastener with projecting stainless steel screw, spring and natural aluminum knob finish. (TSD No.2 shall be flat black.)** **TSD No.1 - 8-32 SOUTHCO #47-62-301-20 or equal.** **TSD No.2 - 8-32 SOUTHCO #47-62-301-60 or equal.** **TSD No.3 - M3 SOUTHCO #47-82-101-10 or equal.**
m	**-**	**Micro**
UL	**-**	**Underwriter's Laboratories, Inc.**
VAC	**-**	**Voltage Alternating Current**
VDC	**-**	**Voltage Direct Current**
VMA	**-**	**Valid Memory Address**
VME	**-**	**Versa Module Eurocard, VMEbus Standard IEEE P1014/D1.2**
x	**-**	**Number Value**
XX	**-**	**Manufacturer's Option**
WDT	**-**	**Watchdog Timer: A monitoring circuit, external to the device watched, which senses an Output Line from the device and reacts**